SILICON CHIP

Australia's World-Class Electronics Magazine!

SOLAR POWERED WIRELESS WEATHER STATION

DECEMBER 2004
ISSN 1030-2662
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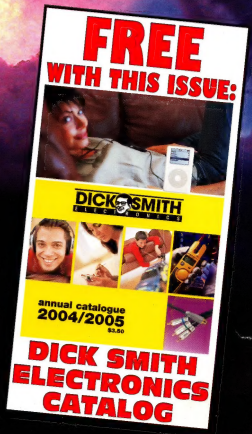

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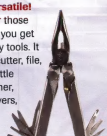

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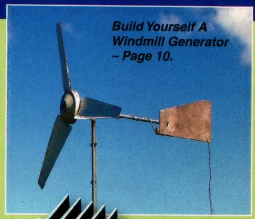

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SILICON CHIP is published 12 times a year by Silicon Chip Publications Pty Ltd. ACN 003 205 490. ABN 49 003 205 490 All material copyright ©. No part of this publication may be reproduced without the written consent of the publisher.

Printing: Hannanprint, Noble Park, Victoria.

Distribution: Network Distribution Company.

Subscription rates: $83.00 per year in Australia. For overseas rates, see the subscription page in this issue.

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ISSN 1030-2662

* Recommended and maximum price only.

PUBLISHER'S LETTER

Human RFID tags for medical records

The US Food and Drug Administration (FDA) has cleared the way for a Florida company to market implantable chips that would provide easy access to individual medical records. Based on the same technology developed by Advanced Digital Systems for pet micro-chipping, VeriChip involves injecting an RFID transponder into a person's arm using a large veterinary needle. For those who want to catch up on RFID (radio frequency identification device) technology, have a look at our articles on the subject in the July 2003 and July 2004 issues of SILICON CHIP.

The VeriChip device contains a unique 16-bit code which could point to the individual's medical records in a national database. Such a national database is not yet available in Australia but the equivalent, the ADS database, is available in the USA to health care providers.

No doubt the FDA approval will bring all sorts of cries of horror from civil libertarian groups but most people will probably conclude that it is a good idea. If you were involved in a serious accident and arrived at the hospital without any identification, as people sometimes do, wouldn't it be great for the hospital to be able to access your records, check for special medical conditions, allergies, prescribed medication and so on?

In fact, would it not be a good idea for hospitals generally? When you were admitted to hospital, you could have the implant and then there would be less chance of getting the wrong medication while you are in a vegetative state. When you leave the hospital, you could possibly opt to have it removed but many people would probably elect to keep it – for next time.

The idea could be introduced at birth. Why not? There could be all sorts of advantages. Your child later goes astray without your knowledge and is later found. Who is he/she? A quick scan and bingo, the authorities know and can take action.

And what about people suffering from Alzheimers? A quick chipping job would no doubt provide greater security against wandering and subsequent treatment when they can no longer communicate.

Sure, such a scheme could be greatly extended and have implications far beyond the initial intention. It could be used to keep unruly people out of sporting venues (not a bad idea) or under-age people out of night clubs. Or a whole host of applications which mean that it could become a de facto identity card.

Want to apply for a bank account? Simple, just get your arm scanned. It would be a whole lot less troublesome than the current 100-point security check. In fact, it could take place of your credit card, driving licence and so on.

Ultimately, this or a similar scheme is probably part of our future. I think it could be good idea. Will it increase the power of the State? Not much probably. If you want to be a part of today's society, it is already pretty difficult to remain invisible to today's huge and all-encompassing databases. And after all, an RFID tag under the skin would probably make identity theft that much harder for the criminals. Or maybe not. What do you think? If you want more information, just do a Google search for VeriChip.

Leo Simpson

Merry Christmas!

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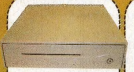

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MAILBAG

Energy Meter kit is first class

I recently purchased the Energy Meter kit (SILICON CHIP, July & August 2004) from Dick Smith Electronics and I must say what a professional job they have done. I have built a lot of kits in my time but nothing to rival this one. The finished product just looks like it was factory built. It was all so easy. Normally PC board switches have to be mounted a certain distance off the board so they protrude the correct distance through the front panel and the same with the LCD module.

But not with this kit; everything is bolted in and with the spacers supplied, everything came to be an absolutely perfect fit. It was also easy to calibrate, although it takes a long time as the calibration stepping is very slow. It is extremely accurate over the entire range and I can highly recommend it. Congratulations to SILICON CHIP for the design and to Dick Smith Electronics for their effort in producing a superb kit.

Paul Cahill,
Rooty Hill, NSW.

Voltage warnings are worthwhile

I would describe myself as a software developer with a passing interest in electronics. Regarding the Publisher's Letter on the topic of high voltage warnings, I feel it's a matter of perspective. I think you do a good job of presenting relevant information for your articles. I don't know what the alternative is but if you are putting colour codes for resistors in articles then why not the warnings?

I have no problems with the PIC projects but there is no way I would have known that the article on the CFL Driver in the same issue (September 2004) was at mains voltage.

If that is the biggest problem in Mr. Hoolhorst's life then I envy him!

On another note, I quietly cringe at how "nerdy" some of the articles sound. I get the feeling that you engineers are really in a world of your own. Every time I read "she who must be obeyed" makes me think that anyone who says that deserves a wife that annoying!

Another example would be in the September issue – in the article "How To Call Long Distance FREE", Ross Tester says: "Telstra claimed 'incompatible infrastructure'".

What does he mean by "claim"? To me, that reads "Telstra have said it's not possible and that the Author thinks that Telstra is not telling the truth." Since he doesn't say, I would be quietly confident that he is using Optus for his home phone. And since the ISP and the customer have to be using the same telephone network, if they are different, it won't work.

Apart from that, it's a great magazine – just a little bit too nerdy.

Christian Payne,
via email.

Comment: Ross Tester is not an Optus telephone customer. And as we understand it, the ISP and the customer do not have to be on the same network.

As far as "she who must be obeyed" is concerned, all wives want their husbands malleable, don't they? And it seems true to us, that people who say that "she must be obeyed" patently don't!

Kit feedback on the PIC Programmer

I recently purchased a Jaycar KC5367, the PIC/serial EEPROM programmer kit, based on the September 2003 article in SILICON CHIP.

As someone just beginning with PICs, I considered buying a ready-made PIC programmer but chose this kit since it was a fraction of the price of the ready-made ones. As a software-only person, nervous around hardware, I felt timid at the prospect of assembling a kit. As someone who'd dabbled in (mainly analog) hardware as a kid, I well knew how easy it is to make mistakes at any step of the way and get badly lost, and end up taking ages to correct the problem (if it could be corrected).

However, I found this kit – the well-engineered PC board, the clearly-labelled components, the excellently written SILICON CHIP article and supplementary instructions – to be of the highest quality.

Construction and testing took me four hours, much less than the 1-2 days I was expecting. To my delight, my first PIC burn/verify succeeded without incident.

Something else that impressed me was how the Jaycar kit included the expensive 18-pin ZIF socket, plus a 16F84A PIC, making it unbeatable value for money.

So this note is just to say thanks for saving me an absolute wad and giving me the satisfaction of building this crucial tool myself. I'd recommend Jaycar kits and SILICON CHIP magazine to anyone.

David McNab,
Auckland, NZ.

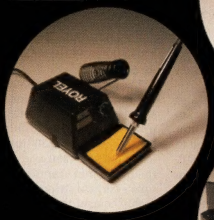
Thanks for your very enthusiastic endorsement David. We know that most people get their kits to work without problems but it is nice when someone pays a compliment like this. It is also worth celebrating the fact that our kit-set suppliers do us proud and a wide range of these SILICON CHIP kits are now selling around the world.

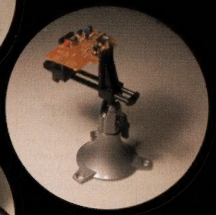
Sprinkler controller circuit has corrosion risk

I would like to advise anyone who makes the Sprinkler Controller depicted in the Circuit Notebook pages of the October 2004 issue to make sure they know where all the valves are located. This is because there is a strong possibility that they will eventually need to rewire them due to corrosion of the wires.

I previously worked for a company involved in designing irrigation control systems. We found that it was essential to have zero DC on the lines to

Royel Digital Soldering Station. $187 incl. GST.
The only Australian made and owned soldering station. Features a Digital Display (200 to 425°C) and a choice of 40W or 60W iron.





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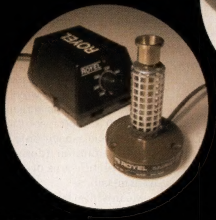

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Mailbag: continued

prevent electrolysis. This was found the hard way. All the wiring in a park had to be replaced. The reason that 24VAC is used is that it does not cause corrosion. The insulation on the wires is usually insufficient to stop the problem.

The corrosion is due to water penetrating the plastic insulation when the cable is buried. It usually takes six months or more to happen. If all the wiring is above ground or in waterproof conduits, then the problem should not occur.

With the PICAXE being so easy to use, I hope many more readers will send in circuits and programs so that others can benefit from their ideas.

Colin Carpenter,
Mosman Park, WA.

Big wrap for valve preamp

I just wanted to congratulate SILICON CHIP and Jim Rowe on the Valve Preamp for HiFi (November 2003). I have just been listening to it and I must say I'm amazed.

I had never heard valves before and I had always been curious but until now they had been too expensive to take the chance on. Your valve preamp has made it affordable to try the "valve sound" and I must say the sound I am getting from my hifi system now is superb.

This valve preamp is so musical and an absolute joy to listen to! I really am taken aback at just how much better sounding this preamp is compared to any solid state preamp I have had. It has made my entire CD collection sound more musical. I don't care that valves aren't technically perfect; the sound is all that matters and this preamp is a winner. Well done and thank you!

Rob,
via email.

Comment: Sound's musical, eh? Now that's a worry.

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Wide-screen digital TV is a mess

In December 2003, I wrote regarding my thoughts on the current state of Digital TV broadcasting in Australia.

Recently, Aldi started selling their own "Medion" brand digital set-top boxes for the princely sum of $169. I couldn't believe this low-cost Chinese-made offering: you just plug it in and it works! All the local channels were already tuned in; all I had to do was tell it where I lived and it automatically sorted out the program guide, local time and so on.

You even get an on-screen signal strength meter to help you set up the antenna! The digital channels came booming in! So now it seems I'm getting Digital TV as advertised. If they can just do something about the fact that most of the time all I'm getting is five copies of the existing analog channels, I'll be ecstatic!

Interestingly, unlike the Thomson units, the Aldi receiver actually does something with the HD transmissions instead of the screen just going blank. You get a series of "stills" which seem to have more resolution than the "live" SD transmissions, although I know that doesn't really make sense on an SD TV.

The whole HD/widescreen thing seems to be going off the rails somewhat, particularly in the USA. Contrary to what was predicted, sales of widescreen sets seem to have gone off the boil. Most of the newer large-screen TV sets I've looked at recently have been standard 4:3, including one "HD-ready" Philips 68cm 100Hz job for $999.

They seem to have somewhat lost the plot with large screens. The Philips set offers a choice of 625-line 50Hz progressive scan, 625-line 100Hz interlace, or 1080/1250 line 50Hz interlace. On 1080/1250, you can hardly see the horizontal scanning lines but the tube's vertical stripe pattern is considerably coarser than even the plain old 625-line horizontal line structure! "HD ready"? Ready for what? Trouble is, the finer the pitch, the more electrons that wind up simply heating up the shadow mask, and the more power consumed, the heftier the scanning circuitry has to be and so on. Most manufacturers have taken the easy way out.

Very few plasma screens offer true HD 1920 x 1080 resolution; in fact a lot of models have only "VGA" 640 x 480 resolution (derived from the visible picture area of ordinary NTSC transmissions).

Meanwhile large-screen LCD displays are racing up on the inside, offering lower cost, lighter weight, less fragility and lower power consumption. The images aren't yet quite up to current plasma or CRT standard but I doubt many people would notice the difference. What's really interesting is that many of them are old-fashioned 4:3, not widescreen 16:9!

This highlights another major stuff-up. As one of your other correspondents has pointed out, if you set your Digital receiver to 16:9 letterbox, a lot of the time you simply wind up with a three-quarter sized 4:3 image, since the stations routinely transmit 4:3 sourced material "vertically letterboxed"! Worse still is vertical-letterboxing of already horizontally-letterboxed SD material!

This is because the authorities blithely assumed that everyone would by now own 16:9 TV sets. What should

have happened was a mandate that all digital set-top boxes be fitted with a 16:9 "flag" signal output and all new 4:3 TV sets set up to switch automatically from this. Ah well hindsight, the only perfect science!

Keith Walters,
via email.

Compact fluorescents are still worthwhile

Your comments regarding CFLs are interesting, especially in regard to the their claimed lifetime and your less than satisfactory experience. However your comment that they're "not worth a candle" is surely opinion taking precedence over simple facts.

A $15 price differential will buy 100kWh of energy (at 15c per kWh) and with 60 watts energy reduction, the unit would need a life of about 1660 hours to become cost neutral (about 4.5 hours per day). Subsequent operation will be a small return on investment, which is more than can be claimed for an incandescent globe.

I have had a CFL installed in a study for over two years and would easily spend 4-5 hours per day with the light on. It would be reasonable to estimate over 3000 hours operation. I understand they are not well suited to highly intermittent use, which may account for the failure rates you are experiencing although your suggestion to validate claims is well made.

With the proliferation of inefficient down-lights – and given that if just 100,000 households substituted one CFL in a 4+ hour, 75W situation, resulting in a saving of 8760MWh per annum – it is not sufficient to draw a conclusion that CFLs are a waste of money. Economic decisions need to consider all forms of impact, both on our pockets and the finite reserves nature provides and entrusts us with.

Roland Denholm,
via email.

CFL light output not evenly distributed

When compact fluorescent lights were first introduced they seemed like a good idea but at over $30 they were just not an economic proposition. They have been greatly improved in design and lowered in price but as you point out in your Publisher's Letter in the August 2004 issue, they have not proved to be anything like as reliable as claimed.

I have always been puzzled by the apparently low light output compared with what is claimed. For instance, I have a 20W lamp which is said to give the same light output as a 100W incandescent lamp. Prompted by Energy Australia's offer of a free lamp, I decided to investigate the disparity a little more closely.

The CFL does indeed emit almost as much light as the incandescent but only in a narrow plane perpendicular to the axis of the tube. Away from that plane, however, the light output rapidly drops off to almost zero on the lamp axis. The incandescent, on the other hand, emits light in an almost uniform sphere, apart, of course, from the region of the base. As a result, I estimate that the total light output of a 20W CFL is about equivalent to a 40W incandescent rather than that of a 100W unit as claimed. The disparity can be overcome in an industrial situation to a large extent by mounting the CFL horizontally in a reflector but this is generally not practicable in a domestic situation.

While there is still a halving of the power input, a 40W incandescent cannot be regarded as producing a useful light output in most domestic situations. I did not take up Energy Australia's offer!

Alan March,
via email.

DC plugpacks that bite

Over the last few years, more and more equipment is powered by plugpacks and as a result you end up with extension boards full of the things. I am a part-time musician and I have a number of guitar effects units which are all powered by plugpacks.

I have been noticing that when I am patching various signal leads, sometimes I get a slight belt (shock). My trusty multimeter tells me there is 9V DC across the plugpack output plug, just as you would expect. But it also tells me there is about 100-110V AC present as well. When I plug the plugpack into any effects unit, then connect a standard guitar lead to the output of the effects unit, when I measure from the shaft of the jack to earth,

Atmel's AVR, from JED in Australia

JED has designed a range of single board computers and modules as a way of using the AVR without SMT board design

The AVR570 module (above) is a way of using an ATmega128 CPU on a user base board without having to lay out the intricate, surface-mounted surrounds of the CPU, and then having to manufacture your board on an SMT robot line. Instead you simply layout a square for four 0.1" spaced socket strips and plug in our pre-tested module. The module has the crystal, resetter, AVR-ISP programming header (and an optional JTAG ICE pad), as well as programming signal switching. For a little extra, we load a DS1305 RTC, crystal and Li battery underneath, which uses SPI and port G.
See JED's www site for a datasheet.

AVR573 Single Board Computer

This board uses the AVR570 module and adds 20 An./Dig. inputs, 12 FET outs, LCD/Kbd, 2xRS232, 1xRS485, 1-Wire, power reg. etc. See www.jedmicro.com.au/avr.htm

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This programmer plugs into a PC printer port and reads, writes and edits any 28 or 32-pin PROM. Comes with plug-pack, cable and software.

Also available is a multi-PROM UV eraser with timer, and a 32/32 PLCC converter.

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that is when I see the high AC voltage. I get a shock when I am grounded by touching the case of my power amplifier and the jack when I am patching units together. Everything works OK but this does not seem normal.

I have a number of plugpacks that do this. Also, my HP Deskjet 840C is run off an 18V plugpack. When I plug the parallel printer cable into the computer, you can see a spark as the shell of the printer cable hits the earthed PC case. Again, I can measure a (relatively) high AC voltage to earth, even though the DC output is spot on.

What is going on here? Do I have a wiring problem in my house? I have an earth-leakage gadget back at the fuse box but it never trips.

Neil Macpherson,
via email.

Comment: it does seem as though this problem is more pronounced with switchmode plugpacks. They seem to measure around 100VAC above Earth compared to 5-10VAC with typical conventional plugpacks (measured with a typical digital multimeter which has 10MΩ input impedance). This voltage leakage is caused by the intrinsic circuit capacitance between mains Active and the output lead and this will naturally tend to be higher in switchmode plugpacks which do not contain a conventional 50Hz transformer.

Even though this may lead to the occasional "tingle" they all seem safe enough and all should have passed the usual compliance tests. Having said that, we would not be inclined to connect any plugpack to equipment while it is switched on – that seems to be asking for damaged circuitry and the shocks you experience.

Mobile phone numbers unknown

I agree with most of your comments in the Publisher's Letter in the November 2004 issue, about fixed telephone lines but there seems to be a basic shortcoming with mobile phones. How do you find another person's mobile phone number?

It is easy to find land-line phone numbers via the "White or Yellow Pages" but there is no equivalent for mobiles. I understand that it is probably impossible to provide one which is up-to-date but there doesn't seem to be a possible solution.

My observations and enquiries indicate that you have to know someone who can give you the number; in other words, a "grapevine". I also get the impression that most young people use mobiles to talk with people they probably see everyday.

In the case of builders and suchlike, it seems to be common to use the Sensis directory and call their land-line which then re-directs the call to a mobile – you still need the land-line to start the process. I think it would be a time-consuming task to use a mobile to look up the Sensis directory to find a land-line phone number, on a very small screen. Telstra used to advertise how you could access the internet via your mobile but I think they have given up promoting such a difficult task.

Ron Sanders,
via email.

Warnings on 240VAC not too cautious

Are you being too cautious with your warnings with 240VAC equipment? (Publisher's Letter, September 2004)? I don't think so. The first thing learned to prevent electric shocks is never to make any assumptions. Watch any experienced electrician approach a faulty piece of equipment: even though it will have been turned off and checked with a voltage probe, habit will still force the wise to initially touch it with the back of the hand to avoid a reflexed grasp if shocked.

The editorial refers to 240V mains Active/Neutral transposition. Let me briefly tell you how I nearly lost my life to a situation like this. I trained and qualified as an electrician in South Africa and after migrating to Australia, became employed in the electronics industry and then the entertainment industry. Participating on a film shoot back in the late 70s before earth leakage detectors were in wide use and well before tagging and testing for extension cords was mandatory on film sets and work sites, I was moving live redhead lighting stands around a film set.

On about the tenth attempt to improve the lighting which was by this time a rats nest of multiple extension cords plugged into multiple distribution boxes, I grabbed hold of two lighting stands, one in each hand to move them to a new position for yet another take. This was very nearly the death of me. I found myself with a lamp in each hand and the full 240VAC across my chest and heart. Frozen and unable to let go for what seemed an age, I finally managed to hurl myself free of one of the stands. It felt like hours but I am told it was more like seconds before I managed to release.

After regaining my composure and wanting to find someone to be the focus for the string of obscenities I had been practising, I set out to investigate how the hell the situation had become that dangerous. The studio boss advised me that all the lights and extension cords had been tested prior to the shoot. Testing in those days prior to more stringent regulations meant "plug them in and see if the light works". I began dismantling and testing the lighting rig.

What was very nearly my demise was a combination of two lights on metal stands with frames correctly terminated to the earth pin. One extension cord was correctly terminated while a second extension cord had Active and Neutral transposed. The third extension cord was the killer; it had Neutral and Earth transposed.

The Neutral/Earth transposition in the absence of earth leakage detectors would appear to work properly; ie, "the light would come on" and it would deliver the full 240AC from Active to Earth. The Neutral/Active transposition would have passed the same cursory test. The second and third extension cords produced the potentially lethal trap. So are you being too cautious with your diligent warnings? Not from my experience you aren't!

Brian Shirley,
via email.

Correction: Victor Barker's letter on page 6 of the November issue made reference to a degausser circuit involving a 150nF charged by a 330Ω resistor. This value should have been 330kΩ.

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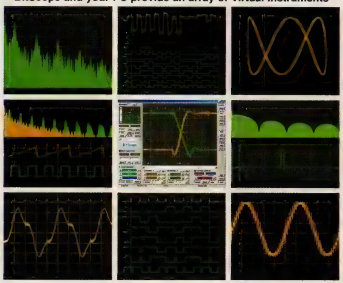

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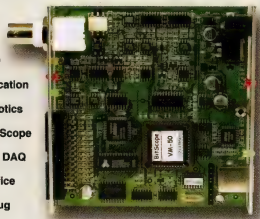

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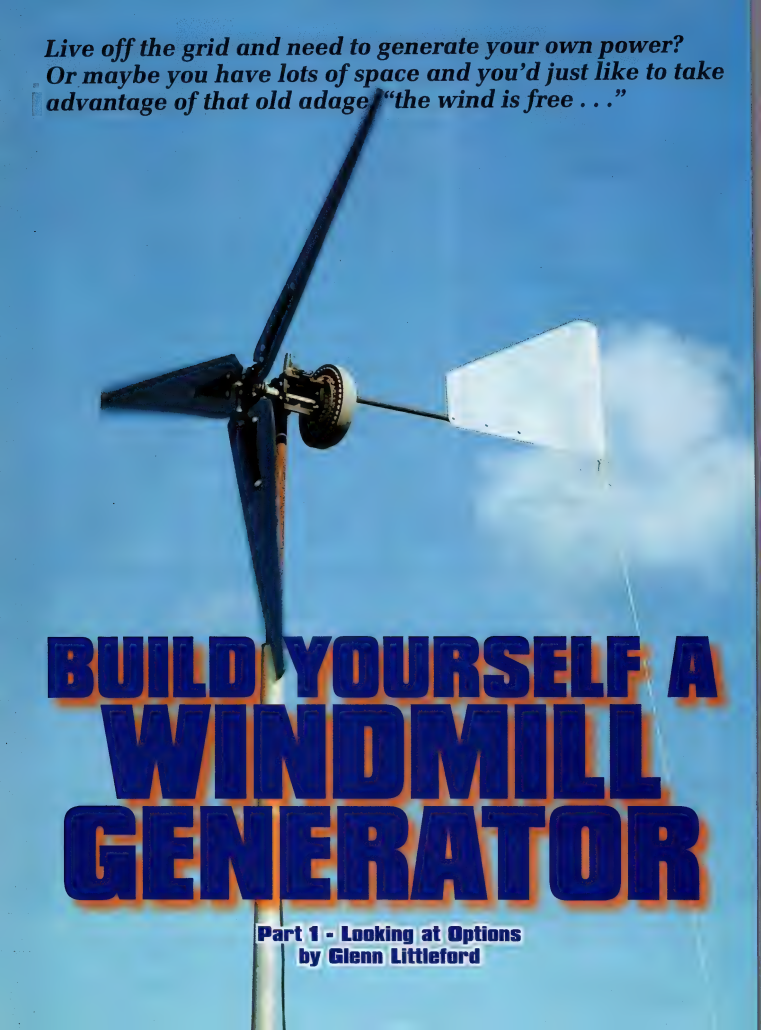
Live off the grid and need to generate your own power? Or maybe you have lots of space and you'd just like to take advantage of that old adage "the wind is free . . ."



BUILD YOURSELF A WINDMILL GENERATOR

Part 1 - Looking at Options

by Glenn Littleford

This windmill uses a small stepper motor from a computer floppy drive to charge nicad batteries.

Alternative energy generation for the home is on the increase, with many domestic installation options on the market, including solar, water and wind generators.

But the initial cost of a "free" power supply is considerable and it can take many years, if ever, to pay for such an installation.

In this article. we look at a new trend in home-made windmills – and next month show you how you can build your own 300W windmill.

Home-made wind generators have been around for decades, with designs as varied as the people who build them. But why would you build your own windmill?

Why not buy a ready-made one, or use solar cells. After all, solar cells are reliable and virtually maintenance free.

The answer is simple: cost!

You can't make your own solar cells at home; they need specialised equipment and clean rooms. But you can build your own wind generator for a fraction of the cost of a similar power sized solar array or commercial wind generator.

Opposite: a motor from a Fisher & Paykel washing machine provides up to 300W in this 2-metre diameter windmill.

Another advantage of a wind generator is it will generate power whenever there is a breeze, night or day!

There are downfalls to wind generation. The wind is not as reliable as solar energy; windmills need occasional maintenance; and location can be a problem.

(A 10m high tower with a 2m diameter windmill in your typical suburban backyard might be frowned on by your neighbors and local authorities).

The best option for the serious home power generation installation is a combination of solar and wind. There will be days of full sunshine and not the slightest hint of a breeze, or days with heavy rain clouds and strong winds.

If you have the space and a location with good year-round winds, then a home-made windmill could be a viable alternative to solar cells. Building your own windmill requires no special abilities or equipment. All you need are some basic handyman skills, a few tools and the time to assemble and experiment.

Using the wind

There is a lot of energy in the wind. Power is proportional to the square of speed, so a 40km/h wind has four times the power of a 20km/h breeze.

As an example, a theoretical perfectly efficient windmill which produces 200W in a 20km/h breeze would rise to 800W in a 40km/h wind and a massive 6400W in a 80km/h storm gust (if it survives!).

But what sort of windmills are we talking about?

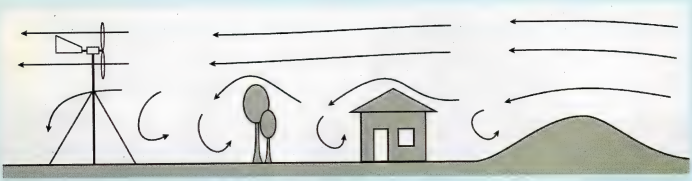
First up, a few simple rules about windmills: they behave in a very similar way to your typical car engine with a power and torque curve and different speeds for maximum power or torque. Ideally, you need to operate your windmill at its peak power output.

The number of blades and their size also affects the speed, torque and power for a given wind velocity:

MORE BLADES = less speed, less power but more torque, perfect for pumping water.
LESS BLADES = more speed.
LARGER PROPELLOR DIAMETER = less speed but more power.

Two other factors to consider are turbulence and wind-shadow. Turbulence can be caused by the disrupted wind from one blade to the next, or anything up-wind of the windmill – and will have a big effect on efficiency.

Wind shadow is the effect the windmill mast has on the propeller as each blade passes the mast. This shadow causes a sudden pressure change be-



Windmills need to be clear of any turbulence to run effectively.

hind the propeller blade and results in vibration.

As a rule, a 3-bladed propeller is the best compromise between power, torque and speed. A 2-blade propeller will run faster but there are dramatic vibration problems with 2-blade windmills during wind direction changes and they are therefore not recommended. A typical home-made wind generator with a 3-blade propeller diameter of 2m will spin from 100 to 600rpm and is capable of generating over 500W.

Windmill blades can be made from just about anything – wood, steel, fiberglass, carbon fibre, etc . . . I've even seen a windmill using eight wheelbarrows! Wood is the most common material for the DIY handyman, its cheap, easily formed, strong and flexible (remember, trees are very good at bending in the wind without breaking).

The profile of a well-designed windmill blade resembles an aircraft wing, giving lift on the trailing edge. There also needs to be a slight twist along the length of the blade.

The blade tip is traveling much faster than the part of the blade closest to the centre of the propeller, so needs to have less angle of attack.

You also need to consider tip speed. A 2-meter diameter propeller spinning at 500rpm has a tip speed of 188kmh. Any airborne dust or unfortunate insects will be very abrasive at this speed.

For windmill blades made from a soft material, such as timber, a layer of wear-resistant material – eg, aluminum tape or fibreglass – should be applied to the leading edge.

Generator

So much for the propeller. What can we use for a generator on a windmill?

There are several options but a common car alternator is not one of them, at least not without modificiation (most beginners to home-made wind generation try to use a surplus car alternator, without much success).

While cheap, readily available and capable of producing over 600W, a car alternator needs to be spun at over 2000rpm before it will generate any useful power.

A windmill large enough to drive an alternator to its full power capacity would not spin fast enough (the larger and more powerful the windmill, the slower it will spin), so you would need a mechanism to step up the windmill speed to over 2000rpm.

You could use a gear set, chain or belt drive but these have disadvantages, including noise, unreliability, poor starting and reduced efficiency.

You need a generator that will produce power at low speed, which is why most successful home-made windmills use permanent magnet alternators.

Large Permanent Magnet DC Motors, like those used in electric wheel chairs and golf buggies are one option. Unfortunately, these are expensive, have relatively low output when used as a generator and need to have the brushes replaced from time to time.

Modified Car Alternators: some success can be achieved by replacing the standard armature with a new machined armature containing perma-

The iconic Aussie outback windmill: big and lots of blades for lots of torque. It's great for pumping water but not much use when it comes to generating power!

nent magnets. While results are better at low speed than a standard alternator, output is still not good.

Modified Induction Motors: single or 3-phase induction motors can be modified by fitting permanent magnets to the armature. This is done by machining the armature (in a lathe), down to a size that will allow you to glue magnets to the armature.

By using strong Neodymium magnets, a typical 1HP induction motor can supply over 10A. The available current is limited by the gauge of the copper wire in the windings, so some hobbyists rewind the motor with heavier wire with good results – in excess of 30A.

A disadvantage of modified induction motors is the power curve. Peak power will be reached at a low RPM, any faster and the power drops off dramatically. This is due to the high number of laminations in the stator, giving a poor high-frequency response.

Switched DC motors: ie Stepper Motors, such as used in most computer equipment, can make fantastic generators! They have good frequency response over a wide operating speed, are readily available and cheap. Larger motors can be sourced from industrial equipment, motion systems and some domestic appliances, including washing machines (more on this later).

One disadvantage of these motors is the cogging effect. Cogging is the vibration you can feel when you try to rotate a stepper motor and is caused by the interaction of the magnets and laminations/poles.

In a windmill applications this can make the windmill hard to start in light winds, as it needs to overcome the first "cog" to get going. Once motion has started, the cogging effect has little impact on performance, other than a slight vibration and whirring noise.

While most motors can be modified to reduce cogging, it's reasonable to suggest that if the wind isn't strong enough to start the windmill, then it's not really windy enough to generate any useful power anyway.

Air Core Generators: one way to reduce the cogging effect is to remove any magnetic material – ie, laminations – from within the coils of your generator. Of course this will reduce the overall efficiency of the generator as the magnetic path isn't concentrated around the coils.

Don't want to do it yourself? Oatley's "off-the-shelf" alternative

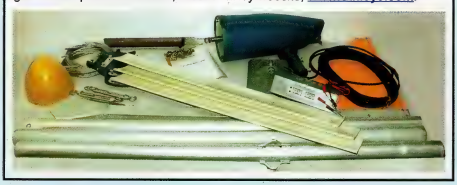
As this article was being prepared for publication, we became aware of this alternative wind generator kit from Oatley Electronics in Sydney.

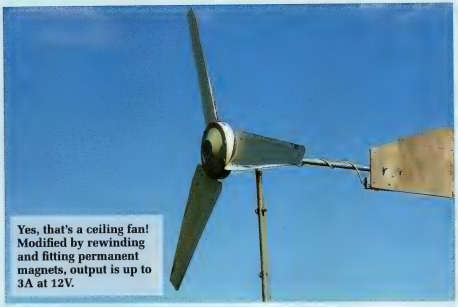
If you're not into rewinding or otherwise modifying motors – or want it NOW! – this "ready to rock and roll" kit could be just what you are looking for – especially as everything you need comes in the kit!

The completed generator, mounted on its mast, is shown above. What you see (in pic below) is what you get – three-phase alternator, mounting plate, three blades, tailfin, nosecone, three-section mast, heavy duty cable, even the stainless steel guy wires, turnbuckles, ground anchors, nuts and bolts . . . in fact, all the hardware you'll need. Also included is a rectifier with voltage and amperage metering.

The generator is capable of 200W output at 12V (or 24V) and the kit sells for $699. Freight must be added and be warned: it's pretty heavy!

For more information, visit the Oatley website, **www.oatleye.com**.





Yes, that's a ceiling fan! Modified by rewinding and fitting permanent magnets, output is up to 3A at 12V.

There have been some clever ways to overcome this problem. One common design is to embed the coils in an epoxy disc which is held stationary, with magnets rotating on each side of the disc.

Good results have been achieved but there are disadvantages. Winding and gluing your own coils into a non-metallic core stator is very time consuming. And as the coils are embedded in epoxy, heat dissipation is poor, making it very easy to cook a set of coils.

Location, location, location

As they say in real estate, it's all about location. An effective windmill needs clean air – that is, a breeze with no obstacles. Obstacles can include trees, buildings and even the contour of the land.

As a rule, the higher the better – but be practical. While a 20m mast might be ideal, you need to get the windmill up there and may need to bring it down for maintenance. Five metres above the nearest obstacle is a good start.

Do not mount the windmill on the roof of your house! All windmills produce some vibration and while this is almost inaudible on a mast, mounted on a roof the vibration could be VERY audible, especially if it finds some resonances.

Also consider safety – things can go wrong. Blades can come off, towers can fall down. So please locate the windmill in a people-free area.

My personal preference is a 7-metre tall folding tower made from 75mm OD, 6mm-wall galvanised pipe. The tower is supported by three 5mm stainless steel guy wires, each connected to a steel post embedded in a 700mm deep hole filled with concrete.

You may need to talk to your local council before erecting a tower and they may require a structural engineer's plan before giving approval.

There is nothing more worrying than watching your windmill buck around in a violent storm . . . and nothing more rewarding than having it survive with no damage!

Using the power

Regulating windmill power is a little more tricky than for solar cells. Solar cells can be open circuited when the storage battery has reached full charge. This is not a good idea for windmills.

Say your windmill is spinning at about 400 RPM in a strong wind, pumping out 20A into a 12V battery. If your regulator suddenly open-circuits the windmill, it has no load and will speed up to, say, 600 RPM. At this high speed the unloaded windmill output could reach over 50V.

If your regulator suddenly reconnects the battery, the windmill output

Left: this strange-looking contraption is my first-ever VAWT (Vertical Axis Wind Turbine) windmill, with its offset bearing shown close-up at right. They have lots of torque and will start in a light breeze. Worth looking into further!

About the author...

Glenn Littleford started in electronics at age 10, as a teenager assembled many electronic kits, and was often called on to fix electronic gadgets for friends and family. The interest in computers started at school with a crash course in programming TRS80's (remember them?)

At 17, he started an apprenticeship with Telecom as a technician and bought his first computer, a Microbee. His Telecom training included radio transmission, power supply systems and computer programming. At age 25, Glenn was made redundant as part of the downsizing of Telstra.

After trying his hand in a range or jobs, including a car mechanic and repairing video arcade machines, he started his own computer repair business.

The introduction of the GST in 2000 convinced Glenn it was easier to be an employee and let someone else worry about tax forms, so he started working as a software developer for an e-commerce business. In 2002, a new career direction was offered as a laser operator.

The use of an industrial laser cutter opened a whole new world to Glenn. Laser cutting gives you the ability to design a part on a computer and five minutes later hold the finished part in your hand. The laser was used to design and build the first of many windmills.

A new job offer to manage a laser cutting department and IT department for a local engineering firm was too good to resist, so Glenn made the move and now works for Swift Engineering in Mackay, Queensland.

A 7-metre tall folding tower made from 75mm OD, 6mm-wall galvanized pipe. The tower is supported by three 5mm stainless steel guy wires, each connected to a steel post embedded in a 700mm deep hole filled with concrete.

current will be excessive and can cause damage.

Remember, the windmill is acting like a big flywheel and will take some time to slow down to a safe speed. Excessive speed can also increase the wear and tear on the windmill, especially bearings and blade tips.

So a suitable regulator will need to switch the windmill output from the battery bank to a dummy load, therefore keeping the windmill RPM down to a reasonable speed.

I use four 100W 12V spotlamps, wired in parallel – but you could also use several electric heater elements. I have heard of installations where heating elements are mounted into the hot water system, so once the batteries are charged the windmill is helping to provide hot water.

Building your own windmill can be a very satisfying experience. I have built several over the last few years, learning from the failures and improving with each new design.

Next month, we will describe how you can build your own 300W windmill using car and washing machine parts, based on an Australian-made short form windmill kit. **SC**

Superbright Lumileds - Indoor & Outdoor LED light fitting range

*** HIGH BRIGHTNESS * LONG LIFE * FULLY DIMMABLE * ENERGY EFFICIENT**

The range of LUMILED downlight fittings shown here have been designed for domestic, display, marine, mobile home and caravan applications. All fittings use Lumileds, which are:
- Long life (typical 100,000 hours) - High efficiency, low power, low voltage - Vibration proof

The OPLLGW series White powder coated. This series is a ceiling type gimballed fitting and require a 57mm diameter cutout (MR11 size).

The OPLLBL series Black powder coated. This series is a stand-alone type for use indoors or outdoors, are fully weatherproof and able to be fully submerged for pond application.

The OPLLBR series Solid Brass. This series is a stand-alone type for use indoors or outdoors, are fully weather-proof and able to be fullysubmerged for pond application.

The OPLLFG series Gold outer rim with chrome inner finish. This series is a ceiling type fixed fitting and require a 51mm diameter cutout (MR11 size).

The OPLLGC series Brushed Stainless Steel finish. This series is a ceiling type gimballed fitting and require a 57mm diameter cutout (MR11 size).

The OPLLGG series Brushed Gold Finish This series is a ceiling type gimballed fitting and require a 57mm diameter cutout (MR11 size).

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Building an audio amplifier is a popular choice when it comes to the hands-on part of electronics courses. We can well imagine the classroom question "Well, does it work?" answered in a flash with "Listen to this, disbeliever!"

That's the best part of building an audio amp; you and your peers actually get to hear the final work punch out a favourite tune or two hundred!

However, amplifiers that produce more than a few watts of power can be difficult to construct and expensive. This is where our new "Schoolies Amp" comes in.

It features a simple board layout for easy construction, is relatively inexpensive and even includes over-temperature and short-circuit protection.

As power amplifier modules go, this unit may not rank at the top for raw power but you'll be hard pressed to find a simpler circuit.

It's based on a single IC, the LM1875T 20W audio amplifier from National Semiconductor. This IC comes in a TO-220 package and, combined with a handful of other parts and a suitable power supply, delivers over 20W RMS into either a 4Ω or 8Ω loudspeaker.

What's more, the specifications are quite impressive for such a bare-bones circuit. With a signal-to-noise (S/N) ratio of 105dB and a distortion figure of less than 0.04% for 1kHz at 20W (see graphs), it could well be used as the basis for a hifi stereo amplifier. The frequency response extends from 14Hz to beyond 100kHz when measured at 1W RMS.

The LM1875 includes an internal 4A current limit, preventing damage should the output be accidentally shorted to ground.

It also includes "safe operating area" (SOA) protection, meaning that the current limit is dynamically reduced according to the voltage present at the output.

Because so much power has to be dissipated by such as small package, the LM1875 also has in-built thermal protection. This effectively shuts the device down if there is excess heat build up in the chip itself (about 170°C).

by PETER SMITH

Design revamp

A similar amplifier module, also based on the LM1875, was presented in the December 1993 edition of Sili-

CON CHIP. By comparison, the Schoolies Amp has slightly better performance and is easier to build.

We achieved these improvements by dispensing with the single supply option that was part of the original design. This left plenty of room to eliminate wire links, increase pad and track size and employ some common sense noise cancelling and grounding techniques.

Circuit description

The circuit diagram (see Fig.1) for the amplifier module reveals just the LM1875 power amplifier (IC1) and a handful of support components.

The closed loop gain of the amplifier is set to 23 by the 22kΩ and 1kΩ resistors on the inverting input (pin 2), following the standard non-inverting amplifier feedback rules (ie, voltage gain = 22k/1k + 1 = 23).

The 22µF capacitor in series with the 1kΩ resistor sets the lower end of the amplifier's frequency response. Another factor in the low-end response is the high-pass filter in the input signal path, formed by the 2.2µF coupling capacitor and 22kΩ resistor.

Overall, the result is a rapid frequency response roll-off below about 10Hz (see Fig.11). Following this, a 1kΩ series resistor and 330pF capacitor form a low-pass filter, eliminating problems with high-frequency noise pickup on the input leads.

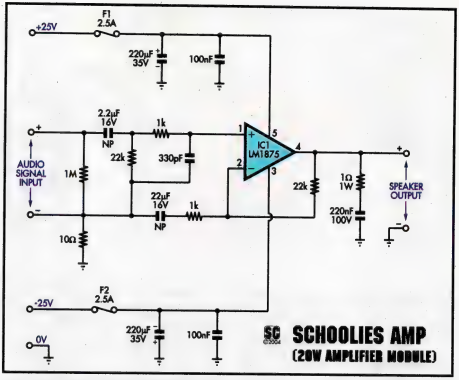
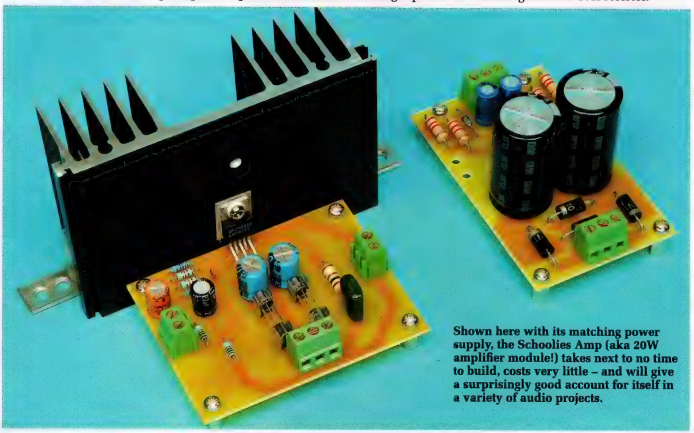


Fig.1: the circuit consists of little more than the LM1875, which contains a complete low-distortion 20W amplifier with overload protection in a 5-pin TO-220 package.

Non-polarised electrolytic capacitors (marked "NP") are used in these positions because the voltages present are too small to polarise conventional electrolytics.

Keen-eyed readers will have detected that the input circuitry is not connected directly to power supply ground, but instead goes via a 10Ω resistor.



Shown here with its matching power supply, the Schoolies Amp (aka 20W amplifier module!) takes next to no time to build, costs very little – and will give a surprisingly good account for itself in a variety of audio projects.

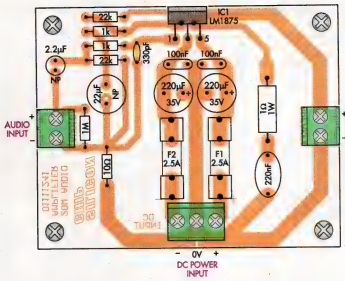


Fig.2: use this diagram when assembling the module. Double-check that you have the two 220µF capacitors in the right way around, as indicated by the "+" markings.

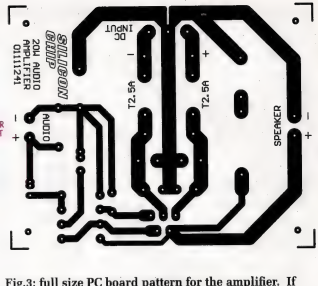


Fig.3: full size PC board pattern for the amplifier. If you're wondering why this looks different to the overlay pattern at left, this view is from the copper side while the overlay is "through the board" as if an X-ray.

This has little effect in a single (mono) amplifier setup but in a stereo setup, it helps to reduce currents circulating in the ground wiring which can degrade separation between channels.

Finally, a 1Ω resistor in series with a 220nF capacitor at the output of the amplifier form a Zobel network, designed to neutralise the effects of the speaker's voice coil inductance at the higher end of the frequency spectrum.

Power supply

The recommended power supply for the module appears in Fig.4. An 80VA mains transformer with two 18V secondary windings or a single 36V centre-tapped winding is recommended. The secondary feeds a full-wave bridge rectifier and filter, formed by four 1N5404 diodes (D1 – D4) and two 4700µF 35V capacitors. The output is about ±25V unloaded and is suitable for powering one or two amplifier modules.

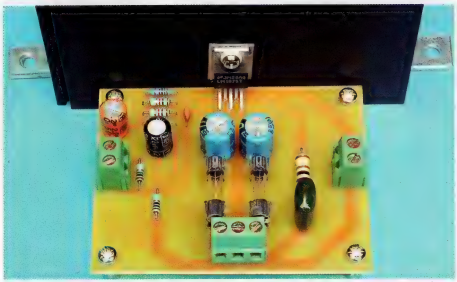
If designing your own power supply, note that the supply rails to the LM1875 must not exceed ±30V. Voltages lower than the recommended ±25V can be used, but available output power will be less than that shown in the performance graphs. Refer to the LM1875 datasheet for more information, available from **www.national.com**.

The circuit also shows a ±15V preamplifier supply, based on two simple zener regulators. This supply is optional and can be left out if not required.

The power supply design is virtually identical to the supply used for our SC480 amplifier, described in the January & February 2003 issues.

In fact, you can use the SC480 power supply kit to power this project, if you team it up with the specified transformer (the higher voltage SC480 transformer can not be used).

If using the SC480 power supply kit, note that the 4 x 2.2kΩ 1W resistors need to be replaced with 2 x 560Ω 1W resistors, as shown on the circuit and overlay diagrams (Figs.4 & 5).



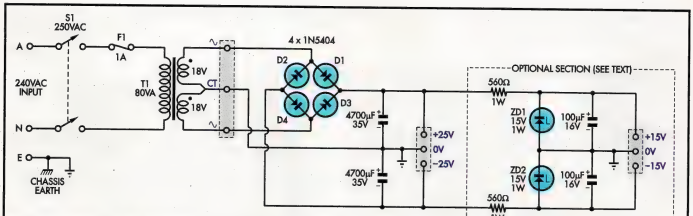
The completed amplifier module is bolted to its heatsink via the LM1875. Take particular care once the amplifier is in this state – it's quite easy to break the legs of the IC if you allow the board to flex with reference to the heatsink.

Construction

Construction of the amplifier module is quite straightforward, with all parts mounting on a small PC board measuring 80mm x 63.5mm. Use the overlay diagram in Fig.2 as a guide to component placement.

The resistors should be installed first, followed by the capacitors. Use your meter to verify the value of resistors where necessary. Note that the two 220µF capacitors are polarised and must go in with their positive leads oriented as indicated on the overlay. The remaining two electrolytic capacitors are non-polarised and can be installed either way around.

Install the fuse clips and terminal blocks next, pushing them all the way down onto the board surface before soldering. Note the retaining tabs on the fuse clips; be sure to orient these



SC 01/2004 **POWER SUPPLY**

Fig.4: the power supply is simple but more than adequate. The ±15V supply is for a preamplifier, if required.

towards the outer (fuse end) side, otherwise you won't be able to plug in the fuses later.

The LM1875 should be installed last of all. Before doing this, fit 10mm tapped spacers to the corner mounting positions of the board. Now slip the LM1875 into position. As its leads are preformed at the factory, they shouldn't require more than minor tweaking for a comfortable fit in the PC board holes.

Make sure that the LM1875 is sitting "square" (ie, perpendicular to the board surface) and then carefully turn the assembly over and solder only the centre pin of the package. The remaining four pins should only be soldered after attachment to the heatsink, so let's do that next.

Heatsink mounting

Place the board and heatsink on a flat surface and bring them together, centring the LM1875 in the available heatsink width (see photos). Dependent on the particular type of heatsink, it may also be necessary to line up the hole in the tab with a gap between fins. Now gently mark around the inside of the tab hole with a sharp pencil.

Centre-punch the pencilled circle and first drill a 1mm pilot hole, then step up to a 3mm (or 1/8-in) bit for the final size.

Once drilled, the edges of the hole must be deburred to obtain a perfectly smooth surface. This can be achieved by gently rotating the tip of a much larger drill in the hole opening by hand, held between the thumb and forefinger.

The LM1875 can now be bolted to the heatsink using a TO-220 insulating kit (ie, a mica washer and insulating bush). Fig.12 shows the assembly details. Smear all mating surfaces with a thin film of heatsink compound before bolting the assembly together. Take care not to "skew" the LM1875 as the screw is tightened.

To complete your work, you must now solder the remaining leads of the LM1875. Gingerly turn the whole assembly over, being careful not to disturb the relationship between the PC board and heatsink.

Place something under the board to support its weight and keep it at right angles to the heatsink while you solder the remaining leads. It's also a good idea to reheat and resolder the centre pin of the IC to relieve any stresses imposed during assembly.

Once done, use your multimeter to confirm that the metal tab of the LM1875 is indeed electrically isolated from the heatsink.

Power supply assembly

The overlay diagram in Fig.5 shows how to populate the SC480 power

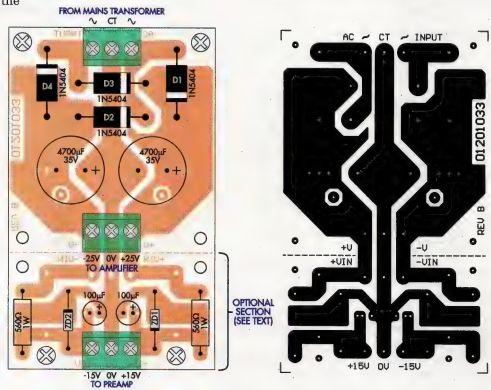


Fig.5: here's how to assemble the power supply board. One of these can power two modules for a stereo setup. Note that the PC board is virtually identical to the one used in the SC480 amplifier – the full size pattern is shown at right (Fig.6).

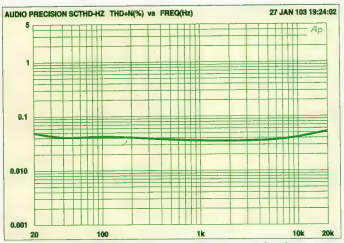


Fig.7: THD versus frequency at 1W into an 8Ω load.

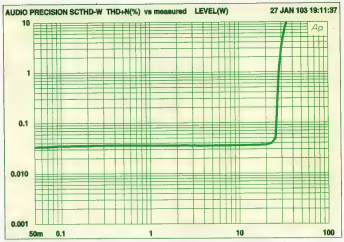


Fig.10: THD versus power at 1kHz into an 8Ω load.

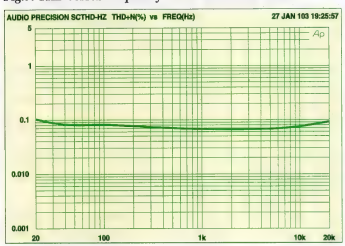


Fig.8: THD versus frequency at 1W into a 4Ω load.

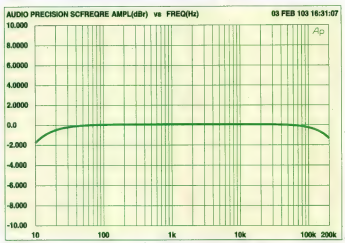


Fig.11: frequency response at 1W into an 8Ω load.

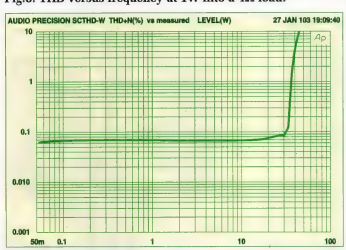


Fig.9: THD versus power at 1kHz into a 4Ω load

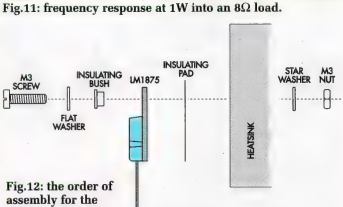


Fig.12: the order of assembly for the various parts when bolting the LM1875 to its heatsink. Interestingly, we found that mica washers smeared lightly with heatsink compound outperformed the various silicone-impregnated washers we had on hand.

supply PC board to suit the Schoolies Amp. Note that we've marked the 4700µF capacitors as 35V rated but higher voltage types are fine too.

The board assembly is even easier than for the amplifier module! Install the four diodes (D1-D4) first, aligning the banded (cathode) ends as shown. Follow with the two 3-way terminal blocks and then the two 4700µF capacitors. Make certain that you have the positive leads of the capacitors around the right way.

Leave out all the remaining components unless you specifically require the ±15V supply for a preamplifier circuit.

Wiring

Use heavy-duty (7.5A) multi-strand

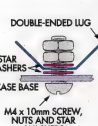


Fig.13: the mains earth must be securely attached to a metal chassis as shown here. Tighten the first nut very firmly before winding on the second "lock-nut". The power supply ground (0V) must also be connected to this point.

Parts List – 20W Amplifier Module

1 PC board coded 01112041, 80mm x 63.5mm
2 2-way 5mm/5.08mm terminal blocks
1 3-way 5mm/5.08mm terminal block
4 M205 PC-mount fuse clips
2 M205 2.5A slow-blow fuses
1 1.4°C/W heatsink (Altronics H 0580, Jaycar HH-8590 or similar)
1 TO-220 insulation kit (bush, insulating washer) & heatsink compound
4 M3 x 10mm tapped spacers
4 M3 x 6mm pan head screws
1 M3 x 10mm pan head screw
5 M3 nuts
1 M3 flat washer

Semiconductors
1 LM1875T 20W audio amplifier (IC1)

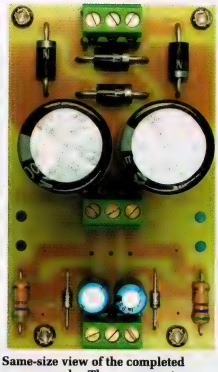
Capacitors
2 220µF 35V PC electrolytic
1 22µF 16V non-polarised (bipolar) PC electrolytic
1 2.2µF 16V non-polarised (bipolar) PC electrolytic
1 220nF 100V metallised polyester "greencap"
2 100nF 50V monolithic ceramic
1 330pF 50V ceramic disc

Resistors (0.25W 1%)
1 1MΩ 2 22kΩ 2 1kΩ
1 10Ω 1 1Ω 1W 5%

Power Supply

1 PC board coded 01201033, 90.2mm x 54.6mm
4 1N5404 3A power diodes (D1-D4)
2 4700µF 35V (or 50V) PC electrolytic capacitors
1 18V+18V 80VA toroidal mains transformer (Altronics M 5118)
2 3-way 5mm/5.08mm terminal blocks
4 M3 x 10mm tapped spacers
4 M3 x 6mm pan head screws

Parts for optional preamp supply section
2 15V 1W zener diodes (ZD1,ZD2)
2 100µF 16V PC electrolytic capacitors
2 560Ω 1W 5% resistors
1 3-way 5mm/5.08mm terminal block



Same-size view of the completed power supply. The components on the bottom are for the optional ±15V preamp power supply.

cable for all DC power and speaker connections. The +25V, -25V and 0V wires to the amplifier module should also be twisted together to minimise radiated noise.

Now on the mains (240VAC) side, be sure to use only mains-rated (250VAC) cable and insulate all exposed connections.

This includes the use of rubber boots or heatshrink tubing on the rear of IEC sockets, switches and fuse holders. The idea is to ensure that even with the covers off and power on, it is impossible to accidentally make contact with live mains voltages.

Mains earth must be connected to a metal chassis using the arrangement shown in Fig.13. Return all earth wires to this point to eliminate potential earth loops.

When in any doubt, refer your work to an experienced person for check-out before connecting to the 240VAC mains outlet for the first time. Never take shortcuts with mains wiring – it could be fatal!

Testing

Before applying power, go back over the board and carefully check that all parts are correctly located and oriented.

That done, install the fuses and connect the power supply leads, taking particular care that you have the positive and negative leads around the right way!

Do not connect the loudspeaker or an audio input signal at this stage.

Note that you must have the heatsink fitted, as the LM1875 has to dissipate substantial power even without an audio signal present.

Check the supply rail voltages first; these must be within 10% of the nominal value.

Finally, check the DC voltage across the loudspeaker terminals. It should be less than ±50mV.

If this checks out, the loudspeaker can be connected (switch off first) and an audio input signal applied for final testing. **SC**

Using the cheaper DSE M-1991 transformer

Dick Smith Electronics have available an alternative economy transformer, the M-1991, which is suitable for this project and offers significant savings over the specified toroidal version, priced at just $9.94!

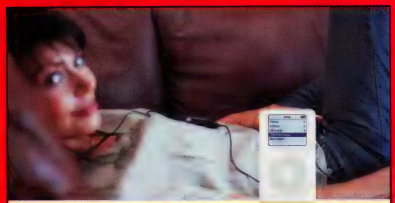
Rated at 60VA, it can be connected as 30V CT (ie, using the 0V-15V-30V taps) to give ±22.4V rails.

This results in slightly reduced power output: 17W RMS into 8Ω and 24W RMS into 4Ω – not enough to be noticeable!

Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	1MΩ	brown black green brown	brown black black yellow brown
2	22kΩ	red red orange brown	red red black red brown
2	1kΩ	brown black red brown	brown black black brown brown
1	10Ω	brown black black brown	brown black black gold brown
1	1Ω	brown black gold gold (5%)	n/a
2	560Ω	green blue brown gold (5%)	n/a

IT'S BACK!



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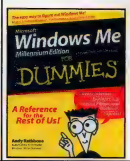

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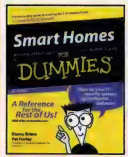

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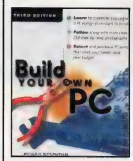

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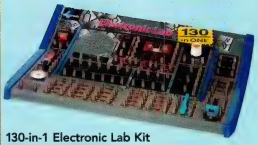

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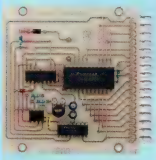

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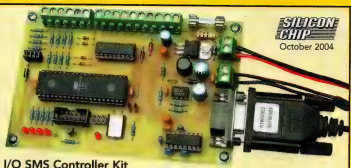
July 2004

Energy Meter Kit
LCD screen displays power in watts, energy usage in kWh, measurement period in hours, energy cost in dollars and cents.
K 7217

$127



SILICON CHIP
October 2004

I/O SMS Controller Kit
Control equipment from anywhere, any time, using SMS and an old Nokia mobile phone. Suitable with Nokia 3210, 3310, 5110 and 6110. Hook up wire and data cable not supplied in kit. K 7221

$79.80

SILICON CHIP
August 2004

Balanced Microphone Amp Kit
Balanced input for microphone, balanced and unbalanced output, level control, 3-band equaliser, runs from battery, plugpack or phantom power.
K 7219 N.B. Photo for illustration purpose only.

$59.87

SILICON CHIP
June 2003

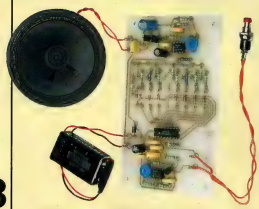
DC-DC Converter Kit
Versatile circuit allows you to run a laptop in your car, charge SLA batteries (6.5Ah or bigger) or run 24V equipment from a 12V battery. Maximum current is 2A.
K 3234

$39.94
SAVE $10

LEGO

Mindstorms Robotics Invention System Version 2.0
Build and programme interactive robots. Uses light, touch and other sensors to activate output motors K 1488

$278

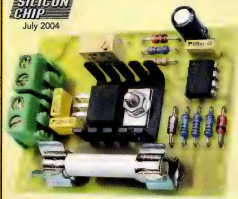


SILICON CHIP
November 1997

10-Note Doorbell Kit
An easy-to-build doorbell chime where you can program your own tune with 10 selectable notes. Install in your existing doorbell housing.
K 3803 N.B. Battery not included.

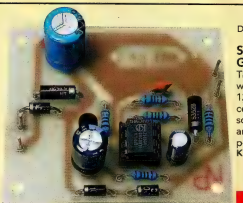
$19.98

SILICON CHIP
July 2004



Micro Battery – Protector Kit
Micro-powered electronic cut-out switch, disconnects load at preset battery voltage, automatically reconnects load when battery recharged. Suitable for 4.8V – 12.5V batteries.
K 3132

$34.67



ETI
December 1987

Solar Generator Kit
This is a cheap, no fuss way to trickle charge a 12V lead acid or gel cell battery using a solar panel. Ideal for any area where mains power is unavailable.
K 3129

$9.85
SAVE $7

Promotion from 24/11/04 to 21/12/04

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NEW

Available at PowerHouse and Mail Order only

DSE

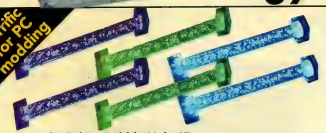
Aluminium LP Storage Case
Stylish polished LP case, holds up to 50 records, lockable.
T 4855

$39.87

WELLER Butane Glue Gun
Operates up to 3hrs on refill, precise temperature control, portable, cordless and lightweight. Incl. 2 glue sticks (Butane Gas sold separately Weller Butane Gas - N 1092). **T 1419**

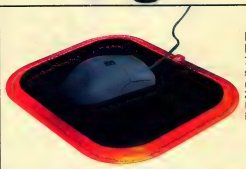
$49.86

Terrific for PC modding



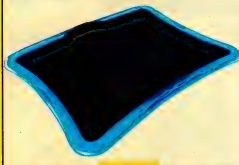
12V DC Multi-Colour Bubble Light Kit
Fantastic lighting effect from hundreds of bubbles embedded inside a pair of 150mm transparent acrylic sticks. **Z 8055**

$24.98



Illuminated FX PC Mouse Pad
7 funky user-selectable colours, runs off USB power.
Z 8400
N.B. Mouse not included

$39.96



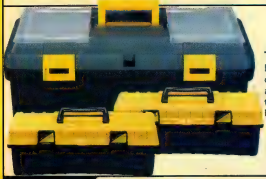
xRaider Blue Illuminated Mouse Pad
Slick easy-glide™ surface, durable and long wearing surface with dimmable lights, USB powered, incl. 1.8m USB power cable.
Z 8402

$29.98

DSE

Soldering Iron and Toolbox Pack
Incl. easy to use, 25W soldering iron and single tray toolbox.
T2304P2

$14.87



Toolbox Combo
Incl. toolbox with component storage and two single tray toolboxes.
H 4597P

$24.98

DSE

389 Piece Terminal Kit
H 5063

$29.84

NEW

DSE

Autoranging Multimeter
An autoranging multimeter with in-built versatility, featuring a large 3.5 digit LCD screen with backlighting, datahold, diode and continuity test, AC/DC, volts, amps, resistance, capacitance, frequency (from 2kHz to 20kHz) and temperature (-40°C to +1000°C) measurement. Supplied with test leads, battery and temperature probe.
Q 1458

$69.98

20MHz Dual Trace Basic CRO
This affordable CRO suits a wide range of applications. Features dual trace, dual trigger with fully adjustable sweep time (20 steps) and sensitivity, selectable trigger modes, AC, TV-H and TV-V trigger coupling, plus more! **Includes 2 probes.**
Q 1802

$498

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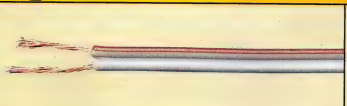


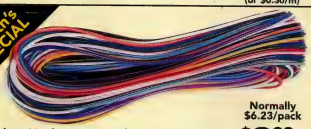
Light Duty Figure 8 Speaker Cable
Ideal for intercoms, sensor line in alarm systems, short run audio connections, etc.
Conductors: 14 x 0.14mm
W 2010

$19 per 100m roll (or $0.30/m)

Medium Duty Figure 8 Speaker Cable
Ideal for intercoms, alarm systems, hi-fi/audio connections, low voltage/low power connections.
Conductors: 14 x 0.2mm
W 2012

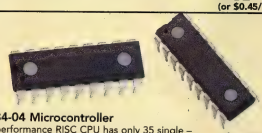
$27 per 100m roll (or $0.45/m)

This Month's SPECIAL



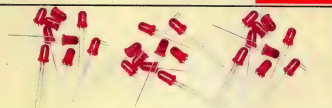
12-Colour Hookup Wire Pack
Pack of 12 x 2m of different coloured strands of light duty wire. All are 10 x 0.12mm cable.
W 4010

Normally $6.23/pack
$3.98 pack
SAVE 35%



PIC 16F84-04 Microcontroller
This high performance RISC CPU has only 35 single – word instructions to learn, 1k Flash program memory, 68 bytes of RAM data memory, 64 bytes of data EEPROM and 4MHz frequency.
Z 9175

$7.91
SAVE 20%



50-piece pack 5mm Red LED
Lens Type: Translucent Red
Viewing angle: 40°
Forward Current: 25mA
Luminous Intensity: 90mcd
Forward Voltage: 2V DC
Dominant Wavelength: 621nm
Z 7060

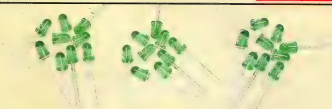
$7.48
SAVE 20%

NEW

PIC16F84A-20MHz Microcontroller
This high performance RISC CPU has only 35 single – word instructions to learn, 1k Flash program memory, 68 bytes of RAM data memory, 64 bytes of data EEPROM and 20MHz frequency. Z 9176

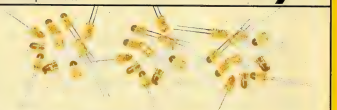
Full data available in DSE website www.dse.com.au or Microchip website

$9.97



5mm Green LED 50-Piece Pack
Lens Type: translucent green
Viewing angle: 40°
Forward Current: 25mA
Luminous Intensity: 60mcd
Forward Voltage: 2.1V DC
Dominant Wavelength: 569nm
Z 7064

$7.48
SAVE 20%



5mm Yellow LED 50-Piece Pack
Lens Type: translucent yellow
Viewing angle: 40°
Forward Current: 25mA
Luminous Intensity: 40mcd
Forward Voltage: 2.1V DC
Dominant Wavelength: 588nm
Z 7068

$7.48
SAVE 20%

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Fax: (02) 9642 9155. Mail: DICK SMITH ELECTRONICS
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Battery Tester with Carry Case
Compact and easy-to-use 15-range battery tester, impact-resistant case.
Q 1001

$19.98

Promotion from 24/11/04 to 21/12/04

DICK SMITH ELECTRONICS

Pt.2 By JOHN CLARKE

A charger for deep-cycle 12V batteries

In this second article on the 3-Step Battery Charger, we present the full construction details, the parts list and set-up procedure. It is designed to fully charge and maintain deep-cycle lead acid batteries, so that they can deliver their full capacity.

THE BATTERY CHARGER is built on three PC boards. These are the Power PC board coded 14111041 and measuring 224 x 77mm, the Control PC board coded 14111042 and measuring 92 x 69mm and the Display PC board coded 14111043 and measuring 141 x 66mm. These are housed inside a metal case measuring 88mm high x 279mm deep x 304mm wide. The Power Controller components are mounted on a fan-assisted heatsink which is cooled using an 80mm 12V fan. The transformer is a 300VA toroid.

On the front panel are the power switch, control switches and the LCD module. At the rear of the case are the charger leads, the temperature sensor input socket, the fuses and the heatsink fan. Also there is a finger guard to cover the fan blades.

Building the PC boards

Before installing any parts, check all the PC boards for any shorts between the copper tracks or for breaks in the connections. Also check the hole sizes. You will need 3mm holes for the mounting screws and the regulator screw. The holes for the power connections at each side of sense resistor R1 and adjacent to transistor Q2 need to be 4mm in diameter to suit M4 screws. The component layouts for all three boards are shown in Fig.6.

Start by installing the PC stakes at the wiring and test points, then install the links and low-wattage resistors on the Power PC board. Use Table 1 as a guide to selecting each resistor and check each value using a multimeter.

Next, insert the diodes (taking care with their orientation), then install IC1 and IC2. Be sure to install the LM358 in the IC1 position, while IC2 must be the LM393. Both ICs must be installed with the correct orientation, as shown on Fig.6.

The trimpots, capacitors and 5W resistors can be inserted next. Note that

the 5W resistors should be mounted about 1mm above the PC board to allow cooling. That done, insert and solder in the R1 sense resistor. When installing the capacitors, make sure that the polarised types are inserted the right way around and that they have the correct voltage ratings for each position.

Leave transistors Q1-Q5 off until the final assembly, to ensure they are set to the correct height for the heatsink mounting holes.

Three M4 x 10mm screws should now be soldered to the underside of the PC board – one on either side of R1 for the power connections and one adjacent to transistor Q2. Each screw is installed from the underside of the PC board and soldered to the large copper areas provided. This will make it easier to complete the connections on the top of the PC board.

Now for the Display PC board assembly – see Fig.6. Begin by installing the diodes, the resistor, the capacitors and trimpot VR5. Note that the 10µF capacitor needs to lie on its side, as shown in the diagram. The pushbutton switches must be orientated with their flat sides facing up, as shown.

Positioning of the LCD will depend on the particular module. The Jaycar module is connected via a dual 7-way header strip, while the Dick Smith and Altronics modules are each connected via a single in-line 14-pin header. Note that the DSE module reads upside down compared to the other two modules. This is solved simply by mounting the PC board upside down in the case.

The ends of the display adjacent to the header connection are supported using M2.5 x 15mm screws and M2.5 nuts. The 4-way and 6-way header pins are right-angle types. Make up the plugs by terminating the 6-way

Main Features

- Suitable for 12V lead acid batteries
- LCD shows charging phase and settings
- Temperature, voltage and current metering
- 3-step charging
- Optional equalisation phase
- Battery temperature compensation
- 16.6A charge capacity
- Initial trickle charge when battery voltage is low
- 4 preset battery chemistry settings
- 2 adjustable specific battery settings (can be set for 6V batteries)
- Correction for voltage drop across battery leads
- Wide battery capacity range (4-250Ah) in 18 steps

Table 1: Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	1MΩ	brown black green brown	brown black black yellow brown
1	910kΩ	white brown yellow brown	white brown black orange brown
1	100kΩ	brown black yellow brown	brown black black orange brown
1	43kΩ	yellow orange orange brown	yellow orange black red brown
4	22kΩ	red red orange brown	red red black red brown
5	10kΩ	brown black orange brown	brown black black red brown
1	5.6kΩ	green blue red brown	green blue black brown brown
2	3.3kΩ	orange orange red brown	orange orange black brown brown
1	1.8kΩ	brown grey red brown	brown grey black brown brown
5	1kΩ	brown black red brown	brown black black brown brown
1	330Ω	orange orange brown brown	orange orange black black brown
1	270Ω	red violet brown brown	red violet black black brown
1	150Ω	brown green brown brown	brown green black black brown
1	120Ω	brown red brown brown	brown red black black brown
1	10Ω	brown black black brown	brown black black gold brown

and 4-way rainbow cable into the header clips and insert the clips into the header shells. The plugs are placed at each end of the wire cabling.

Note that the PC board overlays show a pin 1 orientation for these connectors. Ensure that their polarities are correct.

You can now start work on the Control PC board by installing the resistors, diodes and PC stakes. IC3 and IC4 are soldered directly to the PC board while IC5 (the PIC microcontroller) is mounted in a socket (don't plug IC5 in yet). The regulator mounts horizontally and is secured to the board using an M3 x 10mm screw and M3 nut.

Next, install trimpots VR3 and VR4, making sure the 200Ω trimpot goes into the VR4 position, near the regulator. The capacitors can then be installed, again making sure that the electrolytics are corectly orientated.

Testing the PC boards

The Control and Display PC boards can now be tested for correct operation. First, connect them together using the 4-way and 6-way cabling as shown in Fig.9. Make sure IC5 has not been installed and set trimpot VR4 fully anticlockwise.

Next, apply power (ie, any DC voltage between 12V and 25V) between the +25V supply pin and the GND pin. That done, connect a multimeter set to read 10V between the GND pin and the tab on the regulator (REG1). Adjust VR4 for a 5.0V output.

Assuming all is OK, switch off the power, install IC5 into its socket and solder SENSOR 1 to the PC stakes. Wait a minute or so until the sensor sensor cool after soldering, then install the shorting jumpers JP1 and JP2.

Re-apply power and adjust trimpot VR5 on the display PC board for best display contrast. Check that the display shows **BATTERY AMP HOUR** and **<60Ah>**. Also, press the Set switch and check that the display now shows **BATTERY TYPE** and **<LEAD ACID>**. Press Start and check that the display shows **BULK** and **26 Deg C 0.0V 0.0A** (for example).

Next, adjust trimpot VR3 so that the display shows the same temperature as the ambient (this can be measured using another thermometer). Note that the display reads in 2°C increments, so set the display to the nearest value available. This may need to be re-checked to be sure the reading tracks the ambient value correctly.

To test the Power PC board, apply between 12V and 25V DC to the +25V and GND pins. That done, check the voltage between pins 8 & 4 of IC1 and IC2 – this voltage should be similar to the input supply. The voltage across ZD3 should be close to 5.1V if the supply is around 25V but may be lower than this if the power supply is only 12V.

Drilling the case

You will need to drill quite a few holes and make cutouts in the case. We should note at the outset that the case used in our prototype has a drawback in that its bottom panel has a section of mesh right where we wanted to mount the transformer. This means that it needs an additional large metal plate underneath to provide secure anchoring for the transformer bolt.

Table 2: Capacitor Codes

Value	µF Code	EIA Code	IEC Code
470nF	0.47µF	474	470n
220nF	0.22µF	224	220n
100nF	0.1µF	104	100n
1nF	.001µF	102	1n

On the rear panel, holes and cutouts are required for the fan and finger guards, mini XLR socket, bridge rectifier BR2, blade fuseholder, cable glands for the charger leads, mains cord-grip grommet and the M205 safety fuseholder.

The fan is mounted towards the far edge of the panel. It requires a 75mm diameter cutout and this is made by drilling a series of holes around the perimeter and then knocking out the centre piece. File the cutout to shape.

On the front panel, cutouts and holes are required for the fan outlet and finger guard mounting, the LCD window, the control and power switches and the mounting pillars for Display PC board. The latter holes for the PC board pillars need to be countersunk, to suit countersink screws.

The LCD window cutout required

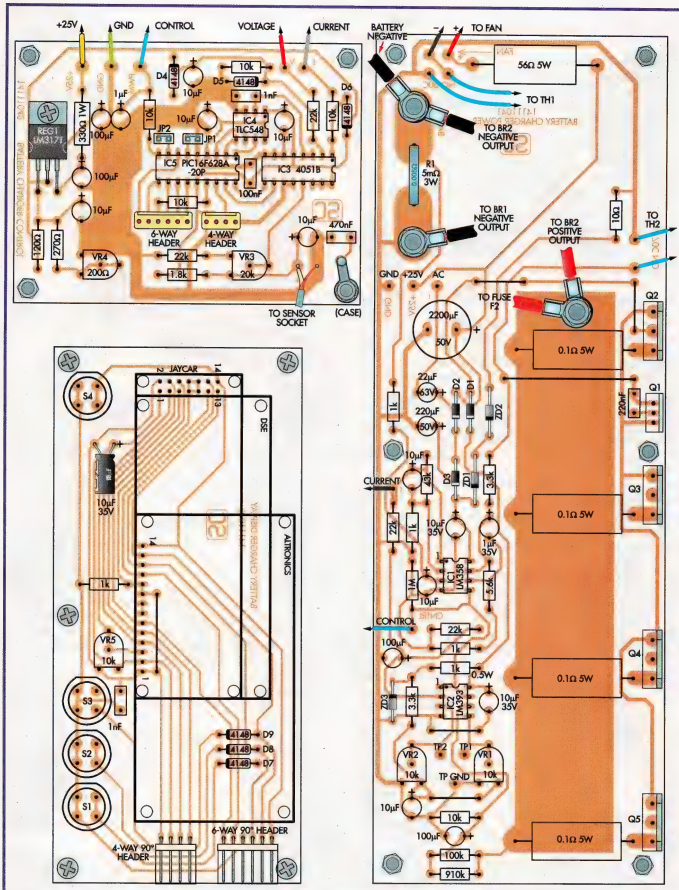

Fig.6: install the parts on the three PC boards as shown in these parts layout diagrams. Take care to ensure all polarised components are correctly orientated, including switches S1-S4 on the display board.

KEY TO HARDWARE CODES

X M3 x 15mm SCREW, 6mm NYLON STANDOFF AND M3 NUT
Y M3 x 15mm NYLON CSK SCREW, 10mm STANDOFF and M3 NUT
Z M3 x 15mm SCREW with M3 NUT
G M4 x 15mm SCREW, M4 STAR WASHER & M4 NUT, YELLOW SLEEVE SOLDER LUG
H M4 x 15mm SCREW & M4 STAR WASHER
I M4 x 15mm SCREW, M4 STAR WASHER & M4 NUT
J M4 x 10mm SCREW & M4 NUT
K M3 x 10mm SCREW & M3 STAR WASHER
L M4 x 10mm SCREW & M4 STAR WASHER
M M4 x 10mm SCREW SOLDERED TO PC BOARD, M4 STAR WASHER & M4 NUT, YELLOW SLEEVED SOLDERLUG(S)
N M3 x 10mm SCREW, M3 STAR WASHER & M3 NUT
O TOROIDAL TRANSFORMER MOUNTING BOLT, NUT & WASHERS
P M4 x 12mm NYLON SCREWS (X6) WITH 0.5mm PLASTIC SHEET INSULATION (NOT SHOWN IN WIRING DIAGRAM – ATTACHES HEATSINK TO BASE PLATE)
Q M2.5 x 15mm SCREWS & M2.5 NUTS (ATTACH LCD MODULE TO DISPLAY PC BOARD)
R M3 x 10mm CSK NYLON SCREWS (6) (HOLDS 0.5mm PLASTIC INSULATION TO TOP OF HEATSINK)
S M3 x 10mm SCREWS & M3 NUTS (FRONT PANEL GRILLE)
T M3 x 10mm SCREWS & M3 NUTS (ATTACH FRONT & REAR PANELS TO BASEPLATE)
U FEMALE INSULATED SPADE CONNECTOR FOR 6.4mm WIRE
V FEMALE INSULATED SPADE CONNECTOR FOR 5.3mm WIRE

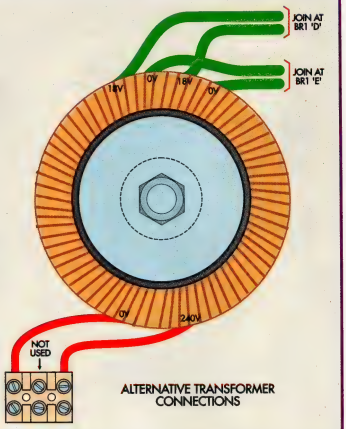

Fig.7: this diagram shows the hardware codes (above) for the main wiring diagram (Fig.8). At right are the wiring connections for an alternative transformer which is available from Jaycar and Altronics.

is 67 x 19mm, suitable for fitting the Perspex window. The fan cutout is half a circle and this is on the side where the heatsink is positioned. The cutout position for the LCD window depends on the particular module that is used. Fit the front panel label and the Perspex window to the front panel.

The front panel can be assembled now. Insert the M3 x 5mm Nylon countersunk screws for the Display PC board mounting and secure these with the 10mm tapped standoffs. The Display PC board is attached to these screws and held in place with M3 nuts. The fan guard is secured with M3 x 10mm screws and M3 nuts, while the the mains switch is simply clipped into its rectangular cutout (make sure that it is a tight fit, so that it doesn't come adrift.

Holes in the box baseplate are required for the mains earth solder lug mounting, the transformer mounting bolt and for mounting the PC boards and the heatsink. In addition, two holes are required for the 3-way mains terminal block.

Our prototype box included side panels which are used to increase the case height and these have side flanges. The panel for the transformer side of the box needs to have these flanges removed. We used a nibbling tool to cut these flanges away and filed the edges down to a smooth finish.

The flanges on the fan side also need to be removed near the fan to allow it to be positioned without fouling. In addition, the front panel requires a 50 x 4mm notch adjacent to where the heatsink mounts on the top and bottom mounting flanges. These are required to allow the heatsink to fit without touching the panel.

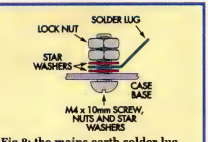

Fig.8: the mains earth solder lug must be securely attached to the metal chassis as shown here. Tighten the first nut very firmly before winding on the second "lock nut". Note: scrape away any paint or powder coating from around the mounting point, to ensure a good connection.

Insulated heatsink mounting

An important aspect of the charger design is the heatsink which is completely insulated from the case. This was done so that no mica or silicone washers are required when mounting the bridge rectifier and the five power transistors (Q1-Q5) and this maximises heat transfer from those components.

As well, it greatly simplifies the high-current power connections to the collectors of the five power transistors. The +18V output from the main bridge rectifier simply connects to the heatsink and since all the transistor collector tabs are also bolted to the heatsink, that makes the connection. Simple – but you do have to make sure the heatsink is properly isolated, so there is no chance of shorts between it and the case.

The heatsink requires tapped holes to mount the bridge rectifier (BR1), the two thermostats, Q1-Q5 and the positive supply connection. In addition, the top and bottom surfaces require six holes each.

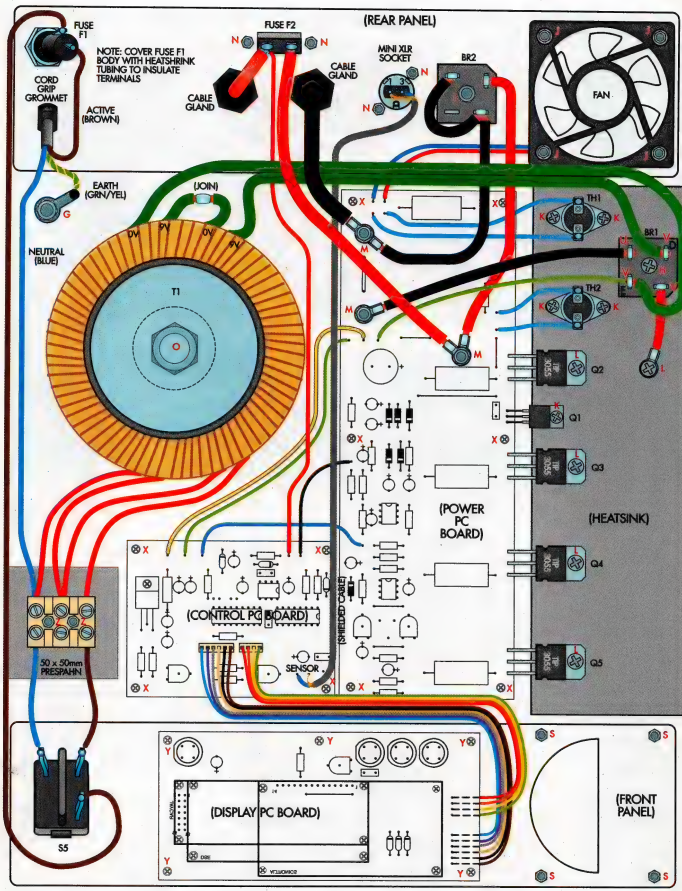

Fig.9: this is the main wiring diagram for the battery charger. Be sure to use heavy-duty cables where indicated (see text) and take care with the mains wiring. The terminals of switch S5 should all be insulated, as should the terminals for Fuse F1. Once the wiring is in place, it should be secured using cable ties, as shown in the photos.

This view shows how the parts are arranged on the rear panel and also shows how the display board is mounted. Be sure to insulate the mains switch terminals and use cable ties to secure the wiring.

A sheet of 0.5mm plastic insulating sheet (225 x 45mm) is fixed to the top and bottom surfaces of the heatsink to ensure that it cannot short to either the base or the lid of the case. The bottom holes are tapped M4, so that the heatsink can be attached to the baseplate using Nylon M4 screws (the plastic sheet is sandwiched between the heatsink and the base of the case).

The holes in the top of the heatsink are tapped M3 so that the second 225 x 45 x 0.5mm plastic sheet can be secured using M3 countersunk Nylon screws. Do not use glue to secure the plastic sheeting.

Fig.10 shows the drilling and tapping details for the heatsink. Again, if you are building this project from a kit, you will not have to worry about and drilling and tapping the heatsink.

Attach the thermal cutouts to the heatsink using a smear of heatsink compound to the back of the sensor before securing them with M3 x 10mm screws and star washers. That done, install the heatsink in the case. Check that it is isolated from case by measuring the resistance between them with a multimeter – the meter should indicate an open circuit.

Installing the Power board

Next, install the PC board standoffs onto the baseplate using the M3 tapped 6mm Nylon standoffs and the M3 x 15mm screws and place the Power PC board in place. That done, insert the five power transistors (Q1-Q5) and adjust their height above the PC board so that the holes in the transistor tabs line up with their respective tapped holes in the heatsink. You can then carefully lift the board out and solder the centre leg of each power transistor. When you've done this, replace the board and re-check alignment before soldering the other transistor leads.

The power transistors can now be bolted to the heatsink. To do this, first, apply a smear of heatsink compound to their mounting faces, then secure the Power PC board in place with M3 nuts. The power transistors can then be fastened to the heatsink using M4 x 10mm screws and star washers. Q1 (BD649) is secured using an M3 x 10mm screw and star washer.

Similarly, apply heatsink compound to the back of bridge rectifier BR1 before securing it in place with an M4 x 15mm screw and star washer. Make sure it is oriented with its positive ("+") terminal positioned as shown.

The Control PC board can now be attached to the baseplate using 6mm standoffs, M3 x 15mm screws and M3 nuts. Note that the lower right mounting point connects the 470nF capacitor to chassis via a solder lug. Check that this is earthed using a multimeter between chassis and this earth point (you should measure this as a short circuit).

Note that one of the extra securing points for connecting the rear panel to the baseplate is located beneath where the fan mounts. The M3 securing nut for this should be glued in place so as to make assembly easier.

Fig.9 shows how the hardware is installed on the rear panel. Secure the bridge rectifier (BR2), the blade fuseholder, the mini XLR panel socket,

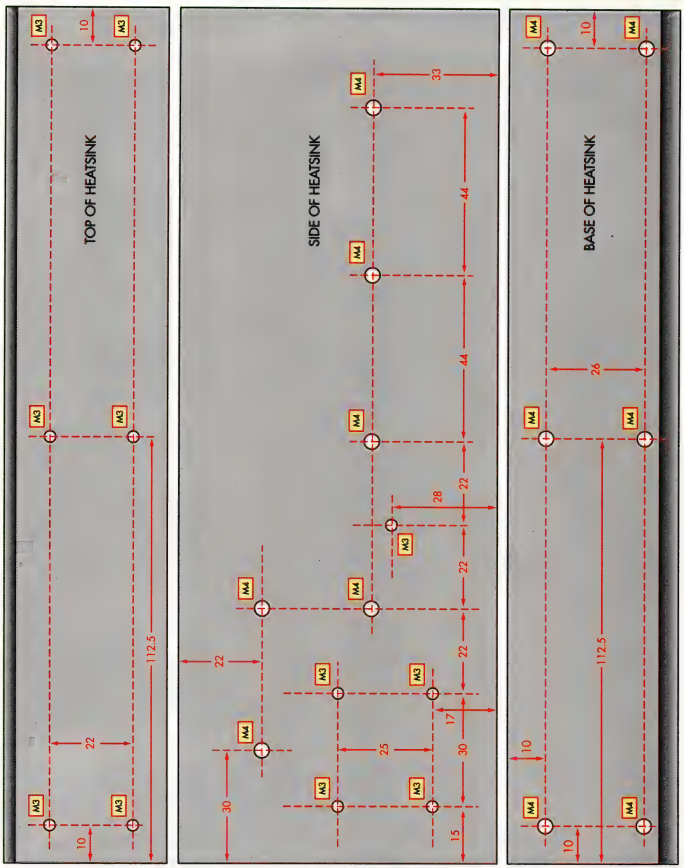

Fig.10: here are the drilling and tapping details for the heatsink. It is completely isolated from the chassis, to avoid using insulation washers for the power devices.

Parts List – Battery Charger

1 Power PC board coded 14111041, 224 x 77mm
1 Control PC board coded 14111042, 92 x 69mm
1 Display PC board coded 14111043, 141 x 66mm
1 front panel label
1 88.1mm high x 279mm deep x 304mm wide metal case (Jaycar HB-5556 or equivalent)
1 240V to 18V 300VA mains toroidal transformer (2 x 9V or 2 x 18V secondaries) (T1)
1 fan-assisted heatsink, 225 long (Jaycar HH-8530 or equivalent)
1 80mm 12VDC 2.4W fan
2 80mm fan finger guards
1 NO 50°C thermostat switch (TH1)
1 NO 70°C Thermostat switch (TH2)
1 M205 panel-mount safety fuseholder (F1) (Altronics S 5992 or equivalent)
1 3A M205 slow blow fuse
1 30A chassis blade fuseholder (F2) (Altronics S 5970 or equivalent)
1 20A blade fuse
10 100mm long cable ties
6 20 x 20 x 8mm large adhesive rubber feet
2 4-8mm waterproof cable glands
1 cordgrip clamp for mains cord
1 7.5A mains cord and plug
1 3-way 10A terminal strip
2 50A insulated battery clips (1 red, 1 black)
2 2.54mm jumper shunts (JP1,JP2)
2 2-way header terminal strips
1 LCD Module (DSE Z 4170, Altronics Z 7000A or Jaycar QP 5515)
1 14-way SIL header strip for Altronics and DSE LCD module
1 14-way DIL header strip for Jaycar LCD module
1 6-way polarised header plug
1 6-way polarised right angle header plug
2 6-way polarised header sockets
1 4-way polarised header plug
1 4-way polarised right angle header plug
2 4-way polarised header sockets
6 5.3mm ID eyelet crimp connectors suiting 6mm wire
9 female insulated 6.4mm spade connectors suiting 4.8mm wire
2 female insulated 6.4mm spade connectors suiting 6mm wire
1 solder lug
1 mini XLR 3-pin line plug
1 mini XLR 3-pin chassis mount socket
1 SPST Neon illuminated 240V 6A rocker switch (S1)
4 White SPST PC board mount tactile snap action switches (S2-S5)
1 18-pin DIL IC socket
10 M3 tapped x 6mm Nylon standoffs
5 M3 tapped x 10mm standoffs
3 M4 x 15mm screws
12 M4 x 10mm screws
6 M4 x 12 Nylon screws
5 M4 nuts
19 M4 star washers
12 M3 x 15 screws
5 M3 x 15mm Nylon countersunk screw
12 M3 x 10mm screws
6 M3 x 6mm Nylon countersunk screws
10 M3 nuts
12 M3 star washers
2 M2.5 x 12mm screws
2 M2.5 nuts
23 PC stakes
1 50 x 50mm piece of Prespahn insulating material
1 67 x 19mm sheet of 2.5-3mm clear Acrylic or Perspex
2 225 x 45mm pieces of 0.5mm flexible sheet plastic to insulate heatsink top and bottom (eg thin plastic chopping mat)
1 225 x 80mm piece of 0.5mm flexible sheet plastic to insulate below the power PC board
2 30 x 70mm pieces of 0.5mm flexible sheet plastic for covering ventilation holes in fan airway tunnel
1 1.5m length of single core shielded cable
1 200mm length of 6-way rainbow cable
1 200mm length of 4-way rainbow cable
1 200mm length of 0.7mm tinned copper wire
1 1.5m 3.3mm squared 30A red automotive wire (12G)
1 1.5m 3.3mm squared 30A black automotive wire (12G)
1 500mm length of 24 x 0.2mm red hookup wire
1 500mm length of 24 x 0.2mm black hookup wire
1 200mm length of 32 x 0.2mm brown hookup wire
1 200mm length of 32 x 0.2mm blue hookup wire
1 100mm length of 16mm heatshrink tubing
1 100mm length of 10mm heatshrink tubing
1 50mm length of 6mm heatshrink tubing

Semiconductors

1 LM358 dual op amp (IC1)
1 LM393 dual comparator (IC2)
1 4051 analog 1 of 8 selector (IC3)
1 TLC548 8-bit serial A/D converter (IC4)
1 PIC16F628A-20P microcontroller

the fan and the fan guard, as shown in this diagram. That done, secure the cable glands for the battery leads and the M205 fuseholder.

The fan should be orientated so that it blows air inside the case. If you look closely, you will see arrows on the fan that indicate the blade direction and airflow (ours was installed with the labelled side facing inside the box).

Note that we have specified extra star washers in the parts list. This is so that you can place them under the screws attaching the panels to assemble the case. The star washers will bite into the metal to ensure the panels are earthed correctly to the baseplate. Note also that you should scrape away any paint or powder coating around the screw holes, to ensure good metal-to-metal contact.

Once the case has been assembled, each separate panel should be checked for a good connection to the baseplate using a multimeter set to read low ohms. Don't skip this step – it's vital to ensure that all panels are correctly earthed, to ensure safety.

Wiring

Fig.9 shows all the wiring details. First, strip back 250mm of the sheathing at the end of the 3-core mains cable.

programmed with battchrg.hex (IC5)
1 BD649 NPN Darlington transistor (Q1)
4 TIP3055 NPN power transistors (Q2–Q5)
1 LM335 temperature sensor (SENSOR1)
1 50A 600V bridge rectifiers (BR1)
1 35A 400V bridge rectifier (BR2)
3 1N4004 1A rectifiers (D1–D3)
6 1N4148 diodes (D4–D9)
2 15V 5W zener diodes (ZD1,ZD2)
1 5.1V 1W zener diode (ZD3)

Capacitors
1 2200µF 50V PC electrolytic
1 220µF 50V PC electrolytic
4 100µF 25V PC electrolytic
1 22µF 63V PC electrolytic
11 10µF 35V PC electrolytic
2 1µF 35V PC electrolytic
1 470nF 50V MKT polyester
1 220nF 50V MKT polyester
1 100nF 50V MKT polyester
2 1nF 50V MKT polyester

Resistors (0.25W 1%)

1 1MΩ	4 1kΩ
1 910kΩ	1 1kΩ 0.5W
1 100kΩ	1 330Ω 1W
1 43kΩ	1 270Ω
4 22kΩ	1 150Ω
5 10kΩ	1 120Ω
1 5.6kΩ	1 56Ω 5W
2 3.3kΩ	1 10Ω
1 1.8kΩ	4 0.1Ω 5W

1 0.005Ω 3W 1% resistor, Welwyn OAR-3 0R005 (Farnell 327-4706)

Trimpots
3 10kΩ horizontal trimpots (VR1,VR2,VR5)
1 20kΩ horizontal trimpot (VR3)
1 200Ω horizontal trimpot (VR4)

Miscellaneous
Heatsink compound, solder.

That done, secure the cord into the back panel using a cord-grip grommet. This grommet needs to be really tight, so that the cord cannot be pulled out. Cut the Active (brown) and the Earth (green/yellow) wires to 70mm length. **The earth wire connects to the solder lug – it should be soldered in place rather than crimped to ensure a good earth connection is made.** Also, scrape away the paint from the earth position on the baseplate to ensure a reliable connection to the case and use an M4 x 15mm screw, a star washer and an M4 nut to attach the lug in place. A second M4 lock nut is then fitted, so that the assembly cannot possibly come undone.

Now measure the resistance between chassis and the earth pin on the mains plug. This should be zero ohms. If not, re-check the connections to chassis. Check also that you get a zero ohm reading between the earth pin of the mains plug and all case panels.

The Active lead is connected to the fuseholder by first passing the wire through a 50mm length of 16mm heatshrink tubing and then soldering it in place. The other terminal of the fuseholder also passes through the heatshrink tubing before it is soldered in place. Finally, slip the heatshrink tubing over the fuseholder before shrinking it down with a hot-air gun.

Note: be sure to use a safety fuseholder for fuse F1, as specified in the parts list.

Transformer mounting

Typically, the mains transformer will be supplied with two circular rubber washers, a dished metal mounting plate and a mounting bolt. As noted previously, the prototype's case required an additional plate underneath to provide secure anchoring for the transformer bolt.

The 3-way mains terminal block is placed over a 50 x 50mm piece of prespahn insulating material and is held in place using two M3 x 15mm screws and M3 nuts. The wiring to the mains side of the power transformer depends on its windings (the power transformer will be supplied with one of two different winding arrangements).

Our transformer came from Oatley Electronics and has 2 x 120V windings and 2 x 9V windings. This requires the two 120V windings to be connected in series, suitable for a 240V mains input. The two 9V windings need to be connected in series to obtain 18V. Other transformers (eg, from Altronics and Jaycar will have a single 240V winding and two 18V windings. The 18V windings will need to be connected in parallel. The different wiring arrangements are shown in Figs.7 & 9.

Use 250VAC-rated wire to connect between the power switch terminals and the terminal block. Insulated 6.3mm crimp spade lugs make the connections to the switch, while the remaining wiring is as shown in Fig.9. Note that heavy-duty 12-gauge wire is used for the connections to BR1 and BR2 and for the screw terminals on the PC board via crimp eyelets.

12-gauge wires are also used for the battery leads. These leads must be exactly 880mm long and they pass through the cable glands in the rear panel and are terminated to the battery clips. The battery clips we used require the jaw to be first removed and the wire passed through the handle of its plastic clip before the lead is soldered.

Note: if you want leads longer than 880mm, you can use heavier gauge wire so that you get 0.01Ω total resistance in both the positive and negative leads **(this exact resistance is required for the control circuit to accurately calculate the voltage loss in the battery leads)**. For example, you can use 2m each of 8-gauge wire (8mm²).

Alternatively, the voltage sensing lead that connects to fuse F2 inside the unit can be extended to the full length of the charger lead and connected to the positive battery clip. This provides remote sensing in the positive lead. In this case, the negative lead could be 1.76m long using 12-gauge wire or 4m long using (thicker) 8-gauge wire.

Heavy-duty hookup wire is used to make the remaining connections to the PC boards, except for the shielded cable used for the temperature sensor lead. This runs from the back of the mini XLR socket to the control PC

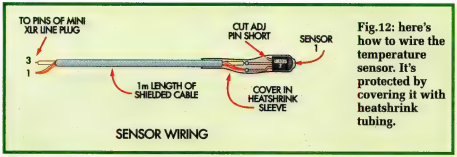

Fig.12: here's how to wire the temperature sensor. It's protected by covering it with heatshrink tubing.

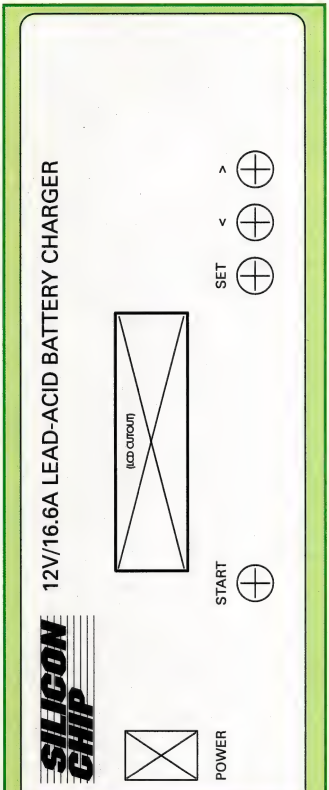

Fig.11: this artwork can be used as a drilling and cutout template for the front panel. Note that the display cutout position shown here is for the Jaycar LCD and is different for the Altronics and DSE LCDs. You can also download a copy of this artwork from www.siliconchip.com.au and print it on polyester "Scotchmark" sheet using a laser printer or photocopier (available from www.wiltronics.com.au).

board. **Cable ties are used to hold the wires together and stop them from coming adrift. This is important for the mains wires – use cable ties to secure the wires at the rear of fuse F1, at the mains switch and at the terminal block.**

Temperature sensor

The temperature sensor (Sensor 1) is mounted at the end of a 900mm length of shielded cable. It can be inserted into a 5mm inside diameter tube and covered in heatshrink tubing. Alternatively, wire the sensor and cover it in heatshrink without the tube. Make sure the probe does not have exposed metal that can short to the battery terminals or to the case.

The other end of the wire connects to pins 1 and 3 of a mini XLR plug. Use the shield connection for pin 1.

Final tests

Do a thorough check of all your wiring, then fit the lid on the case before applying power. Check that the power switch lights up when on. The LCD should also be on.

Next, disconnect power and remove the lid. That done, reconnect power and measure the supply voltage between the GND pin and pin 8 of both IC1 and IC2. These should be around 30V and 25V respectively. Check also that ZD3 has 5.1V across it.

Adjust VR1 so that the voltage between TP1 and TP GND is 1.7V, then adjust VR2 for 1.8V between TP2 and TP GND. This sets the circuit over-voltage and over-current levels to 17V and 18A respectively.

The over-voltage adjustment sets the maximum allowable voltage when charging during equalisation. You may wish to raise this to allow the equalisation to operate for the full three hours. Alternatively, you can reduce the value to prevent damage to any equipment connected to the battery during equalisation. Note that the over-voltage value is restricted to 10-times the TP1 voltage.

Final points

The cooling fan will cycle on and off during charging, particularly at the higher currents. To ensure adequate cooling, the air inlet at the rear of the unit should not be blocked.

When using the charger, make sure that the battery clips are correctly connected to the battery terminals. Check the Ah setting for the battery. Remember that a battery with a reserve capacity (RC) rating will need this value to be multiplied by 0.42 to convert it to the Ah capacity. Also, be sure to set the correct battery type.

At the start of bulk charging, it will take a few seconds to bring the current up to the 25% of Ah current. Note that an already charged battery will cycle through to the float charge in a short space of time. This fast cycling through to float can also indicate a faulty battery, if it has not been charged recently.

The temperature sensor does not necessarily need to be placed on the battery case during charging. In most cases, the sensor can be located adjacent to the battery, to monitor the ambient temperature.

However, the sensor does need to be placed on the battery if it has been brought to the charger from a different temperature environment, such as a cold room. You can secure the sensor to the battery using masking tape. Alternatively, you can use adhesive-backed Velcro material if the battery is to be charged regularly. **SC**

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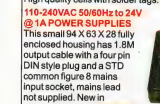

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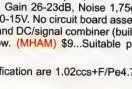

Size: 1130 x 390 x 1000mm Brake: hand brake, rear wheel drum brake. Battery capacity: 12AH, 24V. Battery charger: 240V Motor power: 200W. Charging period: 4-5 hours. Speed: 20km/h. Range: 15km. Wheels: inflatable Frame: painted steel. Weight: 21kg Maximum load: 100kg. Forget waiting for trains and busses that don't come, the regulations on the NSW RTA website indicate that they can be ridden under the same rules as a bicycle. Come complete with batteries, lights and charger. $300 (SC3)

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This portable light weight scooter folds up for easy carrying and storage. Ideal Christmas gift for the kids. Features variable speed control and hand lever style brake. Material: aluminium & steel painted with lacquer. Brake and throttle can be swapped from side to side. Telescopic handlebars to suit most riders. It comes complete with mains charger and batteries. Unlike a lot of others these have Australian electrical approvals including C-TICK. Speed: 12km/h Motor: 100W Battery: 2x 12V, 4.5A Range: 10-15km G.W: 10kg N.W: 8kg Size: 740 x 130 (deck) x 930mm.

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SERVICEMAN'S LOG

Houston, we have a problem

Well, it wasn't really Houston that had the problems this month – it was your truly. They ranged from TV sets with purity errors, to lightning damage, to cockroaches in microwave ovens. I even had trouble with my cordless phone.

Recently, we had a particularly troublesome 1997 Sony KV-T29SZ8 (BG-1S chassis) come in. According to the job card, Mrs Morrison's complaint was that the Standby LED was intermittently flashing and that "the set was dead".

Well, when I switched it on, the picture was perfect except for some purity patches and the sound was fine. I ran it all day but once when I switched it off with the remote and then tried to switch it back on again, it wouldn't! However, I couldn't get it to do this to order – sometimes it would do it and sometimes it just refused.

In fact, it was very frustrating. The set would work perfectly for days and just when I was about to phone Mr Morrison to pick it up, it would play up again.

I took the back off and checked for the usual dry joints, in particular on the horizontal drive transformer, the east-west output transistor and the vertical output IC. But nothing I could see was bad enough to fix this problem.

I also decided to check out the purity problem, which Mrs Morrison hadn't complained of but which was fairly obvious. In fact, there were patches of colour on both the left and the right-hand sides of the screen.

I started by degaussing the screen but that had no effect. I then checked the set's degaussing circuit, especially the PTC (Dual Posistor, positive temperature coefficient). This wasn't rattling – a sure sign of broken or defective discs – and it was soldered perfectly.

You cannot run Sony TV sets without the degaussing coil connected, as this will burn up the 470Ω resistor in series with the PTC, so I disconnected this and tried again. This made no difference, so turned my attention to the deflection yoke.

Lots of dust

From the dust, I could see that it hadn't been disturbed for a very long time and nor had the ring magnets. There were also no signs of magnets being added or missing around the tube shell. This was another mystery and it looked quite serious; after all, it was possible the set had been dropped and the internal shadow mask had moved. If so, replacing the $1000 tube would be the only cure and it wouldn't be worth it.

The only easy way to check this out and resolve the problem was to redo the purity adjustment. However, as I was about to move the deflection yoke, I noticed that it wasn't touching or resting against the rubber wedges. Furthermore, I noticed that by moving the yoke up and down, the purity would vary (along with the convergence). There was a weakness in the plastic housing that went to the clamp and judging by the dust

Making Purity & Convergence Adjustments

Correct colour purity in a TV receiver occurs when the three primary colour electron beams land on their corresponding phosphors on the picture tube. When it is incorrect, you get large blobs or patches of other colours.

To adjust the purity, you first have to line the set up so that the tube faces either east or west, in order to reduce the effect of the Earth's magnetic field (ie, so that it is 90° to the electron guns). That done, you degauss (or demagnetise) the picture tube with a mains-energised wand coil. (This is a much more powerful tool than the set's own internal degaussing circuit).

The procedure is straightforward – first, switch the 240V coil on close to the tube, then in ever decreasing circles, pull the wand away from the tube slowly until you are about three metres away and switch off. This causes any magnetic parts of the TV to be magnetised first one way and then the other at 50 times a second. However, as the coil is pulled away, the magnetic field gets weaker and weaker. Following this procedure, the set should be run at least 15 minutes before starting the purity adjustments.

This job is done using a colour bar generator and the initial adjustments can be carried out using a red raster, as red shows errors quite clearly. However, green is just as good (green being the centre gun).

First, you pull back the deflection yoke until you get three colour patches across the screen. You then rotate the two purity ring magnets closest to the tube until the centre colour is indeed centred symmetrically. That done, the deflection yoke is pushed back in until the screen is completely one colour.

The adjustment should then be checked using the other two colours, before finally testing with a white raster. More often than not, you will not get a clean pure-white raster the first time. In particular, Sony Trinitrons require the addition of stick-on magnets until the screen patches are eliminated.

Next, you have to set up the convergence. The static or centre convergence is adjusted using an additional two sets of rings on the neck of the tube, aligning red and green first, then yellow and magenta, until the crosshatch pattern is perfect in the centre.

The dynamic convergence – which covers the extremities of the screen – is adjusted by moving the deflection yoke front edge up or down or left or right and fitting rubber wedges to hold it in position. This, plus additional magnets fed into the yoke, plus the controls where available, are used to achieve the best compromise for geometry and dynamic convergence.

On a 69cm picture tube, a 2mm error between red and green in the four corners and a 3mm error for blue in the top left and right corners is considered acceptable at the normal viewing distance of three metres. Note that because these adjustments are interactive, they all have to be repeated until the desired effect is reached.

on the assembly, this was probably the case from manufacture.

When I spoke to Mrs Morrison about this, it turned out that the kids moved the TV a lot so that they could use their Sony Playstation and X-Box games consoles. And whenever they did so, the colour patches would appear!

All it required from me was to loosen the clamp and move the yoke forward slightly until it was resting snugly against the wedges. This fixed both the purity and convergence problems completely.

Now for the original problem. I tried using freezing, heating and vibration but I couldn't get a handle on it from anywhere. The picture was now good and all the voltages inside the set were spot on. There is no diagnostic software and all the options were correct.

By now, it was looking like an EEPROM or microprocessor fault but the symptoms were appearing less and less. And after a few weeks, Mrs Morrison was becoming impatient.

Fortunately, after a long wet weekend (aren't they always), I came in and found that the set was completely dead, with just the Standby LED flashing. Well, at least I could now make some meaningful measurements. The power supply was working fine but there was no drive to the horizontal driver transistor (Q801) from pin 40 of the jungle IC (IC300). This is also controlled by Q030 (H-PROT) from pin 27 (HD-SW) of the microprocessor (IC001).

A fork in the road

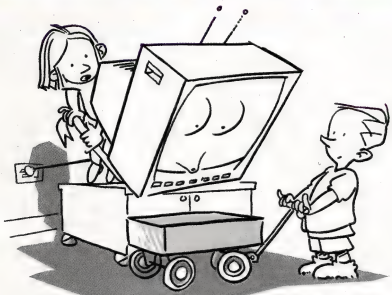
Faced with a fork in the road – ie, whether to follow the analog or digital path – I resolved to check the easiest things first. I swapped the crystals and the EEPROM (IC003) and when these made no difference I bit the bullet and replaced the 56-pin jungle IC (IC300, TDA8375A). When this didn't work, I decided to replace microprocessor IC001 (CXP85224A) but before I could do so, I was called away.

When I returned, I tried to turn the set on one more time and it suddenly burst into life. But although the picture was perfect, there was no sound. By running my fingers under the sound output IC (TA8223K), I soon worked out that no sound was coming from the stereo decoder module (A3).

A little while later, the set wouldn't switch back on again but by now I had triangulated where the problem lay. The A3 module is not only soldered in but is also glued in with white silicone and when you remove, it you still have to take both covers off. Once inside,

Items Covered This Month

- Sony KV-T29SZ8 TV set (BG-1S chassis)
- LG MW60SZ12 LCD TV set
- NEC TV FS-5160 (Chassis No. CG)
- Sony SLV-EZ22A2 VCR
- Panasonic TC-29V26A (M16M) TV set
- Panasonic NV-HD600 VCR
- Sharp R350E microwave oven
- Samsung CE104CFC microwave oven
- Samsung M245 microwave oven
- Pioneer DV266S DVD player
- Panasonic KX-TCM418ALW cordless telephone



the problem was obvious. IC1201, the large 64-pin multi-system stereo decoder microprocessor, was badly dry jointed, as was the 5V regulator (IC1203). Resoldering these finally fixed all the problems to Mrs Morrison's satisfaction.

But why did the faulty stereo decoder kill the whole set. The reason is probably due to noise on the data lines (SCL and SDA) feeding back to the main microprocessor.

The impure LCD

Now purity problems normally only affect cathode ray tubes (CRTs). Recently, however, we were blown away when we had a near-new LCD rear projection TV develop a green purity patch at the bottom on its screen when displaying a blue raster. How could this be so?

The set was an LG model MW60SZ12 and disassembling this monster is no mean feat for two people. Removing the front screen requires a large screwdriver and a hammer and you have to hit the grooved part of the back hard on the right and the left, plus pull the steel front screen off. Similar effort is required to pull off the sound grille.

And this is just the start. To remove the front, top and back mirror and projector engine of this TV takes nearly all morning and involves about 90 screws. Great care also has to be taken with the screen removal, otherwise the speaker will be cut off. Finally, when the projector engine is on the bench, you can remove the polariser filters.

This revealed that the red filter in front of the blue LCD had a large mark on it. The glue between the plastic filter and the glass had come away and formed an air bubble. It had then buckled and become discoloured with the heat from the projector lamp after about 3000 hours of use. This doesn't happen with the other two colours, because they are attached to the lens assembly which conducts the heat away more efficiently.

The replacement is an upgraded clear version (Part No.5018V00021B) of the mirror polariser. When fitting the replacement, you have to very careful not to touch the silver oxide coating and fit it the correct way round. The other side has a plastic protective film which you remove.

A great deal of attention to detail is required during this operation to get everything back in the correct order. If you don't, you will strike problems after it's all been reinstalled another half day later. And because it's so labour intensive, this job isn't cheap.

Lightning damage

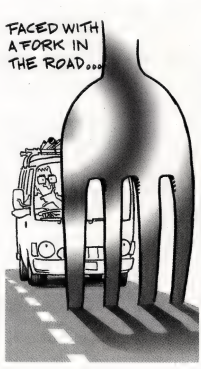
A couple of weeks ago, we had a storm which brought some much-needed rain. It wasn't a particularly bad storm, with just a few lightning strikes a couple of suburbs away.

The next day, however, I got a call from Mrs Francis, whose house, though not actually struck by lightning, wasn't all that far away from a strike point. She had two TVs and two VCRs that were all now dead but her computer, which was fitted with a surge protector, had survived.

The units in the bedroom were a 2001 NEC TV FS-5160 (Chassis No. CG) and a Sony SLV-EZ22A2 VCR. When I removed the covers, I found that no fuses had been blown. However, in the TV, the front face of IC921 (STR-G6653) had blown clean off, while IC1 (TOP225Y) in the Sony VCR had failed. I ordered and replaced both of these and that was all that was wrong with them.

In the lounge, was a Panasonic TC-29V26A (M16M) TV and an NV-HD600 video. Once again, although the fuses were intact, both items were completely dead. In the former, I found R808, a 4.7Ω 15W resistor, to be open circuit and C809 (180µF 400V) to be short.

In the VCR, there was a black mess over the spark gaps on the PC board



but otherwise no visible damage. Replacing IC1 (STRM6559) fixed the power supply and restored the unit to working order.

So why didn't any of the fuses fail? I really don't know – lightning sure is a fickle beast! On the plus side, I was able to fix all the items quickly. Damn, I'm good!

We gotta repair microwave ovens

I had a number of microwave ovens come in this month. The first was a Sharp R350E, a fairly modern microwave just out of warranty. The oven wasn't cooking and the special high-voltage fuse had blown.

When I opened it up, the reason was obvious – it was crawling with cockroaches which had managed to get into the magnetron cavity waveguide. A major cull ensued, followed by a clean up of the corpses (this is one reason why I'm not exactly enthusiastic about repairing these items). I then replaced the expensive fuse and switched it on with a glass of water and a small torch fluoro (without its metal end caps) and watched the latter light up as never before (the microwaves agitate the fluoro's coating so that it gives an intense light).

Next I checked how long it took to boil a cup of water and checked the current drain using a clamp meter (5.9A). Everything was spot on except for the display, which had dropped a few segments. When I relayed this to the client, instead of a "well done, thanks for a good job", I got a full on lecture as to how I personally had stuffed up his display through my own incompetence.

He subsequently picked up the unit in very poor grace and reluctantly paid me for what I had done, still claiming that I was the galah that had ruined the display!

Later, I discovered that Sharp had had problems with these displays and had issued a recall to replace them. I tried to inform my (by now) ex-client but he never returned my phone call. Not that I'm going lose any sleep over this – you reap what you sow.

Samsung microwave

The next microwave was a Samsung M245, an older model but one that is very reliable. This arrived with the complaint that it was dead and the owner did not really want to spend much money. (How can I educate people? My bank manager is constantly telling me my balance really needs people who want to spend lots of money with me!) I said that I would see what I could do using recycled parts!

The high-voltage fuse, though meas-

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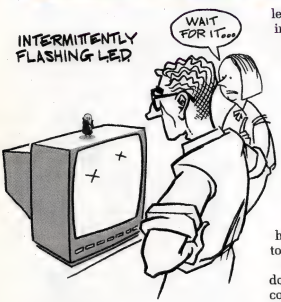

uring OK, was blackened. I replaced the protection diode and then switched it on with a microwave detector inside. It still wasn't cooking and it was only running at half power (3.5A).

I threw in a secondhand Panasonic magnetron and though it was now drawing 5.9A, there were still no microwaves inside the oven. As a result, I checked and replaced all the capacitors and diodes before finally changing the transformer itself (the overwind should measure about 100Ω – this didn't). This finally fixed the cooking problem.

Even though it was a Samsung in name, it was now mainly a secondhand Panasonic on the inside. And, of course, I was curious as to whether it was just the transformer that was causing the problem all along. You know the old saying – "curiosity killed the cat". Well, I didn't want it to kill me and so put the original Samsung magnetron back in to see what would happen. This promptly blew the fuse again!

So it looked as though the old magnetron had failed and taken out the transformer with it as well. This really made it uneconomical to repair – secondhand parts or not.

Finally, I had a Samsung CE104CFC (which is similar to the M1734NCE series) come in under warranty. It had been getting very hot and was now dead.

What had happened was the propeller had fallen off the fan and the ducting had melted from the overheating magnetron. A new magnetron, fan motor and air duct soon made it shipshape again.

DVD/VCR combo

DVD/hifi video combos are selling well these days, along with digital set-top boxes, and I am often contracted to install them.

Recently, a client bought a new unit to go with her TV downstairs. In the process, she relegated her old Pioneer DV266S DVD player to go with a new TV upstairs.

The installation went well with the downstairs units but when it came to connecting the Pioneer DVD player with her new TV, all I got was a blue screen – in other words, the TV was muted.

Initially, I wasn't really sure what was going on, so I reconnected the Pioneer to the Sony TV set downstairs and it too was showing a blue screen. Even so, I didn't really think there was anything wrong with unit.

This Pioneer DVD player is a little more sophisticated than normal sets and, rather fortunately, I soon spotted the "Progressive Scan" label on the front. Somehow (and I don't know how), the player had become stuck in this Progressive Scan mode and was muting both TVs.

In the end, I had to take the player back to the workshop and connect it to a plasma TV with Progressive Scan in order to read the on-screen menu and revert to "Interlace". That done, I was able to take it back and install it properly on the new upstairs TV.

Houston, we have a problem

I have a Panasonic KX-TCM418ALW digital cordless phone. It's been an excellent machine – that is, until recently, when the handset intermittently began losing contact with the base station.

I did all the normal things you would expect of someone who is a complete dork when it comes to phone technology – such as change (unnecessarily) the 3.6 Nicad battery. When that didn't work, I stripped the handset down and looked for dry joints, cracks in the circuit board, corrosion and bad connections. I found nothing.

The base station also seemed to be in full working order, with every button "doing what it oughta". Still, as I hadn't a clue what to do next, I decided to have a peek inside.

I soon found that the power supply was getting a little warm inside, with Q401 (2SD2137), R401 (220Ω) and D401 all looking a little worse for wear. The 9V and 5V rails read 9.63V and 5.90V respectively, which was a little too high for comfort. I replaced all three parts just in case but it made no difference.

At this stage, what I really needed was a service manual and some good advice. Fortunately I know Dalton, who is a whiz with these things, and he soon put me straight.

I was on the right track and it's electrolytic capacitor C404 (330µF 16V) on Q401's emitter in the 9V regulator circuit that's the critical component. This creates spurious noise within the unit as it dries out, corrupting the data. This noise can be seen by connecting a CRO between TP64 (GND) and the metal shield that covers the DSP chip. In fact, up to 4V peak-to-peak of 70.5kHz noise can be seen.

Replacing this capacitor with a 470µF 105°C unit fixes the problem.

Dalton also advised me to make sure that the three charging contacts are perfectly clean and not worn, otherwise they should be replaced. This phone has a 3-stage charging circuit that can deliver a high, medium or trickle charge to the handset battery. When the centre pin (in particular) wears, it develops a microscopic black mark at the point of contact, which introduces high resistance into the ID data circuit. This causes the ID code to be interrupted and so the handset CPU will not be able to update the base unit's ID data, resulting in a link failure.

I followed his instructions to the letter and now I no longer have to use smoke signals to communicate.

By the way, if you suspect that the high-current charge is causing contact damage, you might want to go one stage further and disable this charging mode. This is done simply by removing Q409 or R422 from the base unit.

Of course, the "Ultra-Charge" high-speed charge feature will then no longer work but few people will notice its absence. SC

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SEASONS GREETINGS

December 2004

40 Channel UHF CB Band Transceiver

SAVE $10

Short range communication without mobile phones!

Keep in touch within 1km in the city, or 5km in an open area. Operating on standard 40 channel CB frequencies, they can be used with CB repeaters throughout Australia. Accessories available, see website for details.

Was $49 Cat. DC-1010 **$39.00** or **2 for $69.90**

12VDC Cooler / Warmers

Keep your pies hot, or your beers cold!

A solid state thermoelectric device cools to -26°C, or heats to +65°C relative to ambient temperature. They are a reliable and portable way to transport hot or cold food and drinks over long distances without trouble. They are powered from your car's cigarette lighter socket or a mains plugpack (not included).

4L RED Cat. GH-1376
4L SILVER Cat. GH-1377
Holds 6 x 375mL cans
8L RED Cat. GH-1378
Holds 12 x 375mL cans

4L Versions (eg.) **$44.95**

8 Litre Version **$79.95**

Alcohol Breath Tester with Readout

Displays blood alcohol concentration between 0.00% and 0.1%! This great little unit helps keep the roads safe by providing a compact and portable blood alcohol indication. It provides a good result but should not be relied upon for precise results.

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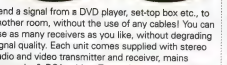
Cat. QM-7292 **$59.95**

2.4GHz Wireless Audio Video Senders

Watch cable TV all over the house!



Send a signal from a DVD player, set-top box etc., to another room, without the use of any cables! You can use as many receivers as you like, without degrading signal quality. Each unit comes supplied with stereo audio and video transmitter and receiver, mains plugpacks & RCA cables. Transmission range is up to 100m, but depends on the type of construction materials used. **Was $99**

SAVE $10

Extra receiver to suit Cat. AR-1833 $69

Cat. AR-1832 **$89.00**

2.4 GHz Wireless A/V Sender with Remote Control Extender

With the addition of an IR remote control repeater you can change the channel of the source device etc from the other room. **Was $139**

SAVE $30

Extra receiver to suit Cat. AR-1831 $89

Cat. AR-1830 **$109.00**

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A great aid for draftsmen too!

Cat. XC-0375 **$19.95**

KIT OF THE MONTH

RGB to Component Video Converter Kit

NEW KIT

Video Standards Converter

Ref: SC August '04. There are some huge benifits to using high quality video signals.

Enjoy the high quality of RGB video when your projector, plasma TV etc only supports Component video inputs. Kit includes PCB, case, silk-screened and punched panels, colour coded RCA sockets, 9VAC plugpack, and all electronic components.

Cat. KC-5398 **$89.95**

Wi Fi Hot Spot and RF Bug Detector

NEW 2004

Quickly check for wireless network access, or wireless devices!

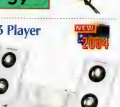
Now you can check for wireless connectivity without having to boot up your laptop! It measures just 75 x 37 x 10mm with an LED strength meter.

Cat. XC-4885 **$39.95**

Portable iPod / MP3 Player Dock and Speakers

NEW 2004

Featuring 1.5" micro speakers, and an internal amplifier, they sound great. It all folds up to a neat 286g package when not in use too. Powered by 4 x AAA batteries.



Cat. XC-5163 **$89.95**

20W "Schoolies Amp" Kit

NEW KIT

A great low cost project!

Ref: SC Nov 2004. Amplifier projects can sometimes become quite expensive, but not this one. It uses a simple, but effective design to give 20WRMS into a four or eight ohm load. Kit supplied with PCB, and all electronic components. Requires +/- 25V power supply, use KC-5347. Heatsink not included.

Cat. KC-5451 **$19.95**

Mini Digital Video Camera

NEW 2004

Fantastic price!

This easy to use camera fits in the palm of your hand! The recorded video can be transferred to a computer for editing, or simply viewed directly on any TV. Supplied with camera bag, cables and software.

- 3.1 mega pixel software resolution for stills.
- 1.5" colour LCD screen.
- 5 layer glass lens.
- 32MB internal memory with expansion slot
- Internal microphone and lots more!

New improved model with 32MB internal memory

Cat. QC-3230 **$249.00**

5.1 Multimedia Speakers

NEW 2004

Compact, stylish, and functional! This unit will accept a stereo signal, or decoded AC-3 inputs & distribute it to produce a wonderfully presented sound stage. 2.5" satellite speakers, and a 6.5" woofer. 55WRMS system power.

Cat. XC-5169 **$99.95**

Stylish PC Speakers

Who said PC speakers had to be drab and boring? These sound as good as they look, and will be right at home in a modern set up. The perspex panels also light up to enhance the effect. See website for details.

NEW 2004

Cat. XC-5167 **$39.95**

USB 2.0 Multimedia Speakers

NEW 2004

Simple audio!

These great looking stereo speakers plug into your computer's USB port for power and audio. They are 'plug n play' so there is no hassles with installation and the 2" speakers provide crystal clear reproduction.

Cat. XC-5162 **$39.95**

"Norbert" Robotic Vacuum Cleaner

Sit back and relax while your robot cleans the house!
It automatically moves around obstacles, and an intelligent optical sensor assists in avoiding walls & obstructions. Works best to supplement your manual cleaner, not replace it.
Cat. GH-1395
Spare Dust Filters Pk 2 Cat. GH-1396 $29.95
Mop Papers Pk 100 Cat. GH-1397 $24.95

Cat. GH-1395 **$249.00**

The Amazing Flygun!

Keep the kids entertained!
The Amazing Flygun is a safe, fun, and effective method of killing flies and mosquitoes. Launch the spring powered swatter at your target! It is safe, fun and really does work!

Cat. YS-5545 **$7.95**

Galileo Thermometers

Invented by Galileo hundreds of years ago! These thermometers are as beautiful to look at as they are functional. The glass spheres rise and fall in the liquid column to indicate current room temperature.
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GG-2102 38cm
GG-2104 53cm

Cat. GG-2100 **$29.95** Cat. GG-2102 **$49.95** Cat. GG-2104 **$79.95**

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Ever lasting memories!
You can record up to a 10 second voice message to accompany each photo. It is great for keeping memories alive, or sending to a distant relative.
Holds 24 - 6" x 4" photos
Cat. XC-0288
Holds 36 - 6" x 4" photos
Cat. XC-0289

Cat. XC-0288 **$44.95** Cat. XC-0289 **$59.95**

Going On Holidays? Use our Automatic Pet Feeder!

NEW! 2004

Don't worry about troubling your neighbours!
Just put the food in and program the timer for 8, 12, or 24hrs. It will then slide open the lid and play your recorded voice message so your pet knows it's dinner time! Three separate compartments.

Cat. GH-1190 **$49.95**

2.4GHz Portable Video Baby Monitor / Wireless Monitoring System

NEW! 2004

Keep more than an ear out for your sleeping baby.
Why not keep an eye on them as well? An integrated 45mm LCD allows you to see and hear your child. Camera features 6 IR LEDs for 'night vision', so you don't even need a light on. The applications of this system don't stop there however, you could use it for any remote monitoring application! Up to 3 cameras can be used with the receiver.

Cat. QC-3280 **$259.00**

Extra cameras also available
Cat. QC-3281
Only $189.00

Air Powered Rocket Launcher and Pump

NEW! 2004

Great fun for the whole family!
The missiles launch spectacularly into the air with the simple use of a hand pump. They launch over 30m into the air!

Cat. GT-3006 **$29.95**

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A simple way of taking temperature!
No thermometers in mouths and squirming kids, just take a quick check with our ear thermometer. Supplied with 20 disposable covers.

Cat. QM-7227 **$49.95**

Personal Fans with Water Spray

Keep your cool!
These fans have a water spray to use on those scorching summer days.
Small size GH-1070
Large size GH-1072

Cat. GH-1070 **$3.95** Cat. GH-1072 **$7.95**

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It will create a refreshing breeze to keep you cool. Measures 130(W) x 160(D) x 75(H) folded.

Cat. GH-1074 **$9.95**

High Power Ultrasonic Pest Repeller

Keep the pests out without chemicals!
It uses frequency-shifting techniques at a loud 140dB to protect an area up to 3000 square feet.

Cat. YS-5520 **$34.95**

Mini Waterproof Camping Lantern

Floats if dropped in water!
It is completely waterproof, and stands about 160mm tall.

Cat. ST-3033 **$12.95**

Personal Fan with Storage Compartment

The ideal beach companion!
It has soft blades for safety and a storage compartment to keep your valuables safe too. Requires 2 x AA batteries.
Limited qty.

Cat. YX-2590 **$5.00**

Personal Air Humidifier / Conditioner

Great on hot or dry days!
It acts as a humidifier for those dry days, or it can blow cool air on hot days! 12VDC powered.

Cat. YS-2810 **$29.95**

Electronic Candles

Look just like tea candles!
There is no messy wax or danger, they provide safe, intimate illumination. Powered by internal rechargeable batteries, includes charger. See website for extra candles. **Was $29.95**

Cat. ST-3922 **$24.95**

SAVE $5

128MB MP3 Player with LCD Screen

NEW! 2004

Great music portability!
It can store up to two hours of MP3 music or four hours of WMA music. It has 5 inbuilt equalisation settings for optimum sound, and can operate just as a USB flash disk.

Cat. GE-4001 **$149**

Image Media Player

NEW! 2004

Digital slide shows on your TV!
Just insert your memory card and plug it into the composite input on your TV! It also acts as a card reader when connected to your PC.

Cat. XC-4857 **$149.00**

Aromatherapy Table Lamp

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Relaxing aromas will fill your room without the danger of candles. Lavender, sandalwood, and lemongrass supplied. Mains powered.
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Cat. GH-1045 **$29.95**

SAVE $10

Memory Card Type MP3 Player

NEW! 2004

A cheap alternative! It has no internal memory, instead using standard SD cards (available separately), giving you a cheap, high capacity MP3 player. See website for details. Measures just 57(W) x 45(H) x 12(D)mm and runs on 1 AAA battery.

Cat. GE-4003 **$69.95**

USB Powered Coffee Mug

NEW! 2004

No more cold coffee!
This great little unit will ensure that your hot beverages won't go cold throughout the day. 75mm dia heating coaster.

Cat. GH-1365 **$24.95**

FOR INFORMATION AND ORDERING
TELEPHONE> 1800 022 888 INTERNET> www.jaycar.com.au

4 Hour Digital Voice Recorder

Compact size, long storage!
It will store up to 4 hours of voice quality audio, in up to four message groups for accessibility. Includes VOX function and more! See website for details.

Cat. XC-0286
$169.00

Parabolic Microphone

Move over 007!
This great unit amplifies sounds from afar, as well as an integrated monocular viewer with 10 times magnification, and a 12 second digital voice recorder.

Cat. AM-4100
$89.95

Spymaster Audio Listener

Tiny, but effective!
It will amplify sounds up to 40dB, with a hearing range of around 15m. It really does work quite well. You will be amazed.

Cat. AA-2027
$19.95

40 Channel UHF Transceiver with CTCSS

Cut out CB traffic noise!
It remains silent until 'called' from another CTCSS equipped transceiver. Up to 5km range
Was $79.95

SAVE $20

Cat. DC-1030
$59.95

1.5W High Powered UHF CB Band Transceiver

Massive range! Up to 8km working range with a hi/lo setting to conserve power.
Was $119

Cat. DC-1040
$99.00

SAVE $20

40Ch UHF CB Transceiver Wrist Watch

Full function in a wrist watch! They are extremely portable, and use internal rechargeable batteries. Up to 2km range.

NEW! 2004

Cat. DC-1070
$199PR

100k Mini Digital Camera

Pocket sized at just 60 x 43 x 17mm, with a maximum capacity of 80 photos.

Cat. QC-3190
$29.95

Binoculars with 300k Digital Camera

Fantastic 8x magnification binoculars.
They have an integrated camera to take photos from a distance. Up to 100 seconds of video can also be recorded.Measures 110 x 90 x 46mm. **Was $74.95**

Cat. QC-3198
$64.95

SAVE $10

Super Bright Luxeon LED Torches

The brightest LEDs in the world!
Luxeon LEDs provide outstanding light output for their size and efficiency. They are available in various sizes to suit a wide range of applications.

Cat. ST-3333

Cat. ST-3334

Cat. ST-3338

ST-3333 - 1 Watt Torch $59.95
ST-3334 - 3 Watt Torch $89.95
ST-3338 - 5 Watt Torch $149.95
ST-3321 - 1 Watt Head Torch $69.95

Cat. ST-3321

EXCALIBUR ELECTRONIC GAMING PRODUCTS

We have found a great new range of products designed in the USA. They are of excellent quality, just drop into your local store for a look!

Electronic Touch Screen Chess and Checkers

Pocket sized entertainment! You can play against the computer, or even use it as a 'chess trainer', with the computer suggesting the next best move. It also offers a great game of checkers.

NEW! 2004

Cat. GT-3512
$79.95

Electronic Quiz Master

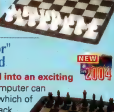
Strain your brain! Over 2200 challenging questions covering 280 different topics. Questions are randomly selected, and it caters for up to 4 players. It is great fun, and is sure to keep you entertained.

NEW! 2004

Cat. GE-4230
$49.95

Two in One Chess Computer

Great gaming options! Use the unit handheld on its own, or plug it into the unique Excalibur game board for a real electronic game. The computer can offer hints on moves, and more!

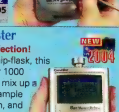


Cat. GT-3510
$69.95

NEW! 2004

New York Times Electronic Crossword Puzzle

Hours of fun! Over 1000 crosswords taken from the New York Times newspaper. They are sorted into three levels of difficulty, and is all operated through the touch screen interface.



NEW! 2004

Cat. GE-4232
$119.95

"Ivan the Conqueror" Talking Chess Board

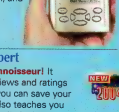
Ordinary chess, evolved into an exciting battle! The intelligent computer can suggest moves, tell you which of your pieces are under attack, and more! Great sound effects add extra life to the game too.

NEW! 2004

Cat. GT-3514
$149.95

Electronic Bar Master

Mix every drink to perfection!
Designed to look like a hip-flask, this great gadget stores over 1000 drink recipes so you can mix up a storm. It also includes sample toasts for every occasion, and even bar jokes.



NEW! 2004

Cat. GE-4212
$49.95

Electronic Wine Expert

The electronic wine connoisseur! It contains over 10,000 reviews and ratings from wine experts, and you can save your own information too. It also teaches you wine basics including terminologies and descriptions.

NEW! 2004

Cat. GE-4210
$49.95

Handheld Electronic Pool

No need to go to the pub! You can choose from a game of 8 ball, or traditional pool. It uses a 'virtual cue' to give you control, with a pool table simulated on the screen. Great fun!

NEW! 2004

Cat. GT-3500
$29.95

LCD Desk Clock with Thermometer

Stylish and functional!
It has a great EL blue backlight, as well as calendar and temperature display. Measures 117(H) x 90(W) x 62(D)mm.

Cat. XC-0226
$34.95

Soccer Alarm Clock

Attention soccer fanatics!
This is one alarm you won't sleep through. It plays 'ole ole ole' when the alarm goes off.

Cat. XC-0246
$24.95

Disco Alarm Clock

An alarm with a difference!
Wake up to upbeat disco tunes instead of the usual screeching that we all know and love. Measures 155 x 130 x 125mm.

Cat. XC-0160
$29.95

Electronic Pin Clock

Looks fantastic!
It features banks of pins that move back and forward to form numbers, which in turn display the time. It is great to watch, and functional too!
•Mains powered.

Cat. XC-0170
$99.00

DARTBOARDS!

Great for Christmas! Keep your party alive with these great games! See our website for further details

Tabletop Magnetic Dartboard
•270mm diameter.
Cat. GH-1034 $9.95

Wall Mount Magnetic Dartboard
•430mm diameter.
Cat. GH-1036 $19.95

Roll-Up Magnetic Dartboard
•435 x 375mm.
Cat. GH-1037 $19.95

Mini Electronic Dartboard
•275 x 210 x 40mm.
Cat. GH-1038 $24.95

Electronic Talking Dartboard
Automatic scoring and voice announcement!
Cat. GH-1030 $69.95

Mini Radio Controlled Cars

Great gift idea!
They measure just 65mm long, and are great fun. Modelled on actual cars. Two types available:

Turbo Feature:
Nissan Skyline - GT-3030 Toyota Supra - GT-3031
Mitsubishi EVO-VII - GT-3032 Mazda RX-7 - GT-3033
Mitsubishi Eclipse - GT-3034

Sound Effects:
Nissan Skyline - GT-3035 Toyota Supra - GT-3036
Mitsubishi EVO-VII - GT-3037 Mazda RX-7 - GT-3038
Mitsubishi Eclipse - GT-3039

All Types (ea) $19.95

Novelty Desktop Mini Golf

Challenge yourself!
See who can sink that chip or putt. Moveable hole for variation. See website for details.
Cat. GT-3150 $9.95

Radio Controlled Submarines

Great underwater fun!
They have full manoeuvrability with forward, reverse, left and right, and a power dive function. Two types available:
27MHz Yellow Cat. GT-3044
40MHz Blue Cat. GT-3045

Both types $29.95ea

Radio Controlled Clown Fish

Swims underwater!
It has full manoeuvrability with forward, reverse, left and right, and a power dive function. Great fun.
Cat. GT-3225 $29.95

Radio Controlled Boat

Great fun on the water!
This little beauty speeds around the bathtub or pool with full manoeuvrability. Uses an internal battery that is recharged with the battery pack.
Cat. GT-3410 $29.95

Rude and Crude... But just for laughs!

Animated Pen Stand

Your Grandmother won't like it, but you will!
It lets out a series of amusing sounds and lifts its head when you insert a pen into the rear-facing rectal receptacle.
Cat. GT-3110 $19.95

Farting Salt n Pepper Shakers

A great gag for all occasions.
They make a fart sound when tipped upside down. Great for parties!
Cat. GH-1080 $19.95

Hand Held Farting Keyring

Every practical joker should have one!
Makes a great farting sound when the button is pressed.
Cat. GH-1082 $9.95

Novelty Boss Voodoo Doll

Show your boss what you really think! Twist his arms, break his legs, and he will be begging for you to come back to work with a pay rise. Great fun for every one.
Cat. GT-3104 $24.95

Remote Controlled Secret Farter

The new millennium's whoopee cushion!
Activated by a remote control, it has three realistic fart sounds.
Cat. GH-1088 $19.95

Novelty Animated "Fat Bastard" Doll

A must for Austin Powers fans!
The Scottish-accented, repulsive character from the movie is a barrel of laughs. He will belch, fart, or say one of eight hilarious phrases.
Cat. GT-3106 $29.95

Novelty Animated Farting Man

Endless fun for practical jokers!
He turns his head and lets out farting noises when someone passes by.
•250mm tall.
Cat. GT-3100 $24.95

Novelty Badge with Orgasm Sounds

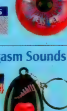
Gives a whole new meaning to "Touch Me There"!
Wear this badge and you are sure to be the centre of attention as everyone tries to push your buttons.
Cat. GT-3315 $9.95

Novelty Animated Flashing Man

For the practical joker's bar!
He looks around, then opens it coat and drops his pants to the tune of Beethoven's 5th symphony, then Stevie Wonder's Superstition.
Cat. GT-3102 $24.95

Novelty Keychain with Orgasm Sounds

Everyone will want what you're having!
Keep this little beauty in your pocket or purse. It lets out orgasmic sounds at the press of a button. What a laugh!
Cat. GT-3325 $9.95



Shocking Shooting Game

A great skirmish game!
Test your aim, and your nerves! You and your opponent strap on the chest targets, set the guns to 'wimp' or 'tough guy' shock level, and GO FOR IT! If you are 'hit', you get a mild shock through the gun's handgrip. Two guns and vests supplied.
Cat. GH-1098 $79.95

Shocking Lie Detector

Liar liar, pants on fire!
Your mates will tremble as you question them about the size of fish they say they caught. If they lie, they will receive a mild shock. Great fun at your next party. HONEST!
Cat. GH-1093 $44.95

Shocking Tank Battle Set

These futuristic looking remote control tanks have IR cannons to fire at each other. Look out though, if you get hit, you will receive a mild shock! A great way to play.
•Supplied as a pair.
Cat. GH-1099 $99.95

Electric Shock Reaction Game

How quick are you?
Wait for the light to change from red to green, then hit the button. If you are the last, you will receive a mild shock, but don't jump the gun or you will get one too!
Cat. GH-1095 $49.95

FOR INFORMATION AND ORDERING
TELEPHONE> 1800 022 888 INTERNET> www.jaycar.com.au

STOCKING FILLERS FOR UNDER $20

5 in 1 Multi-Tool

Folds up to fit in your pocket!

It houses a Phillips and slotted screwdriver, bottle opener, saw, and pliers with wire cutter. Measures: 70 x 30 x 17mm when folded.

Cat. TH-1906 **$14.95**

Keyring Screwdrivers

Never get caught without one!

They have a #2 Phillips, and 6mm slotted screwdriver. Chrome-Vanadium steel for long lasting strength.

Cat. TD-2012 **$2.95**

Data Hold DMM

Great for the electronics enthusiast!

It features diode testing, 10A current, 600VAC/DC, holster, and much more. Great features for the price!

Cat. QM-1520 **$14.95**

Go / No Go Alcohol Breath Tester

Simple indication!

This unit gives you a quick and easy indication of your blood alcohol content. A LED simply illuminates on readings over 0.05%. Great value!

Cat. QM-7290 **$19.95**

Touch Screen Data Bank Keychain

Multiple functions from this tiny unit!

Store names, phone numbers, email addresses, and more. Includes alarm clock, calculator and world time too. •65(L)x42(W)x15(D)mm.

Cat. XC-0182 **$19.95**

FM Auto Scan Radio

Measures just 44 x 44mm!

At the touch of a button it will scan for stations. It is so small you won't even notice it on your belt while running or jogging etc.

Cat. AR-1770 **$9.95**

Faraday Hand Powered LED Torch

No batteries required!

Just shake it up and down to charge the internal battery, which in turn powers the LED. Waterproof, and floats in water. Measures 165 x 38(dia)mm.

Larger model also available: 235 x 40(dia)mm. Cat. ST-3342 $24.95

Cat. ST-3340 **$14.95**

Mini Talking Alarm Clock

Announces the time at the touch of a button!

It also has an alarm which can be set to "cuckoo", cock crow, or a conventional beep. Measures: 30 x 77 x 23mm.

Cat. XC-0238 **$14.95**

Electronic Toy Safes

Ideal protection against... siblings!

Features an illuminated keypad and programmable combination, with voice or sound effects. •185(H) x 135(W) x 125(D)mm.

Pink Cat. GH-1310 Blue Cat. GH-1311

All Colours (ea) **$19.95**

Digital Tyre Pressure Gauge

NEW 2004

Stay safe on the roads!

Incorrect tyre pressures can have adverse affects on handling and stopping distance. Keep check on your tyre pressures easily. 0 to 150PSI range.

Cat. GG-2310 **$19.95**

12V Camping Shower

Wash away the cares of the day - no matter how far from civilisation you are!

The camping shower allows you to take a shower wherever you are. Powered by your vehicle's 12V battery.

Cat. VS-2800 **$19.95**

CHRISTMAS GIFT IDEAS FOR UNDER $50

Talking Pedometer with FM Radio

NEW 2004

Listen to music while you burn calories!

It announces the steps, distance, calories burnt and exercise time when you press the TALK button, or automatically at intervals. Integrated auto-scan FM radio with earphones included.

Cat. XC-0265 **$29.95**

7 LED Diving Torch

Waterproof to 30m!

It features 7 high brightness white LEDs, and a rubber hand grip. Supplied with O-ring grease for marine applications. Made in Japan!

Cat. ST-3076 **$49.95** NEW 2004

Shortwave Receiver

A great portable radio!

It is manually tuneable, but has an LCD to display the precise tuned frequency. It receives AM, FM, and Short Wave signals between 5.95 and 21.85MHz.

Cat. AR-1798 **$39.95**

Remote Controlled Battle Tanks

Great desktop battles!

Complete with sound effects, infrared cannons, rotating turrets, and even recoil simulations, these tanks are great fun to play with. Get two and battle a friend!

Panther tank Cat. GT-3046
Sherman tank Cat. GT-3048

Both Types (ea) **$39.95**

4 in 1 Mars Rover, Boat & Submarine

This thing will go anywhere!

Whether it is driving over rough terrain, crossing water, or diving deep into it, this great craft will do it. It uses a skid steer drive system, or detach the wheels for full use of the props. Approx 180mm long.

NEW 2004

Cat. GT-3320 **$49.95**

Remote Controlled Flying Saucer

Soar to new heights of excitement!

This untethered flying saucer will soar into the air, while you maintain full control over its height. A small internal battery can be recharged on the landing base. Saucer dia. is 230mm.

Cat. GT-3004 **$49.95**

Formula 1 Alarm Clock

NEW 2004

A great way to start the day!

The sound of a Formula 1 motor and a loud hailer voice over saying "Wake Up, Wake Up" gets you revved up to start the day.

Cat. AR-1734 **$39.95**

Fishing Tool Set

A must have for every recreational fisherman!

It includes a 14 in 1 multi tool, 0 - 6kg scales, and an LED hand torch, all in a convenient belt pouch.

Cat. TD-2053 **$29.95** NEW 2004

Handheld Electronic Compass

More than your average compass!

It also features a precision stopwatch, alarm clock, and thermometer! The high quality LCD is easy to read, and operation is simple with the various buttons.

Cat. QM-7282 **$49.95**

Rock Climbing and Hiking Altimeter

Great for hiking or rock climbing trips this summer!

The rugged aneroid mechanism allows measurement from sea level to 5000 metres. Includes a small compass, thermometer, lanyard, and belt clip.

Cat. QM-7280 **$49.95**

Desktop Thermometer / Barometer / Hygrometer

Stylish and functional!

They feature classy analogue dials, and a brushed metal finish. They can be desk or wall mounted. Measure 188 x 88 x 31mm.

Black Cat. XC-0312
Silver Cat. XC-0310

Both Types (ea) **$24.95**

In Wall Speakers

A great mounting solution!
If space is limited, or you simply don't want free standing speakers, then these are a great option for you. 8 ohm impedance allows them to be used in an array of applications. See website for details.
2 Way Cat. CS-2440 $99.00
3 Way Cat. CS-2442 $149.00

2 Way Ceiling Speakers

NEW! 2004

Great quality sound!
Most ceiling speakers are just simple single speaker designs. These dual cone speakers are superior, suitable for a wide range of applications.
Two way 6.5" driver CS-2446 $89.95
Two way 8" drivar CS-2448 $119.95

7" Widescreen TFT LCD Monitors for Cars

All 12VDC powered with infra red remotes. See our website for full features & specs

Standard Mount 7" Monitor

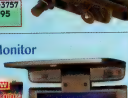
Great versatility!
It offers wide viewing angles, image reverse, and more!
Cat. QM-3752 **$399.00**

Headrest Bracket to Suit

Great versatile mounting option.
NEW! 2004
Cat. QM-3757 **$14.95**

Roof Mount 7" Monitor

Ideal for rear seat viewing!
It has integrated dome lights in the console, so you can replace your factory interior light.
NEW! 2004
Cat. QM-3751 **$419.00**



Dash Mount 7" Monitor

NEW! 2004

Retractable!
This unit folds down to store into a single DIN space (standard car stereo space) so it will go unnoticed.
Cat. QM-3753 **$449.00**

Economy Car Alarm

Basic protection for your car! Includes black box controller, two transmitter keyfobs, shock sensor, ignition cut out relay, bonnet pin switch, siren, and wiring. **Was $119**
Cat. LA-9000 **$99.00**
SAVE $20

TFT / Plasma Screen Wall Bracket

Completely adjustable!
It can tilt and swivel to give you the best viewing angle. Suits screens with 75mm or 100mm VESA fittings up to 8kg.
NEW! 2004
Cat. CW-2814 **$39.95**

Wall Mount Speaker Brackets

Suits Lifestyle series!
Ideal for mounting home cinema effects speakers. Maximum capacity of 5kg, and fully adjustable. Sold as a pair.
NEW! 2004
Cat. CW-2820 **$19.95**

3 Channel Mixer

NEW! 2004

Use up to three microphones with one input!
This great unit will allow you to connect multiple microphones, and also adjust their audio level. 6.35mm connections, 3m output lead.
Cat. AM-4220 **$24.95**

Desktop Broadcast Microphone

Ideal for PA applications!
It features a flexible 165mm gooseneck attached to a sturdy aluminium base. It has a "push to talk" and "lock" switch for convenience.
NEW! 2004
Cat. AM-4088 **$59.95**

B&W Video Doorphone

See who's at your door before you let them in!
The 4" screen lets you see your visitors, and you can talk to them through the handset. Supplied with all mounting hardware and wiring.
Cat. QC-3602 **$199.00**

Colour Video Doorphone

Even better viewing!
The colour camera, and LCD screen give you excellent clarity to the picture. Supplied with all mounting hardware and wiring.
Cat. QC-3604 **$399.00**

Wireless Doorbell / Intercom with Door Strike Control

NEW! 2004

Open the door from anywhere! This great unit acts as an intercom, with a wireless receiver Take it out the back, or around the house. It also has electronic door strike control, so you can let your visitors in too!
Cat. AI-5510 **$129.00**

Full Feature Car Alarm

Extra security for peace of mind! Includes black box controller, two transmitter keyfobs, shock sensor, ignition cut out relay, bonnet pin switch, battery backup siren, and wiring. **Was $199**
SAVE $50
Cat. LA-9005 **$149.00**

3 Piece Surround Sound Add-On

Enjoy the surround sound experience.

The centre speaker contains a screened 4" mid/woofer, and 2" tweeter with a 6 ohm impedance. The two rear speakers contain a 4" full range with a 4 ohm impedance.
2004 Cat Price $99.95
SAVE $30
Cat. CS-2465 **$69.95**

Party Speakers

Add life to your next party!
They make excellent 'add on' speakers to extend your stereo's sound, and will add a new dimension to your music.
12" Party Speaker CS-2512
15" Party Speaker CS-2515
Cat. CS-2515 **$179.00**
Cat. CS-2512 **$139.00**

15" version shown

12 / 240V PA Amplifier

Get yourself heard!
It can be powered from a 12V battery, or mains supply, making it very versatile. 20WRMS @ 4 ohm output, or 30W max.
•Suits 4 - 16 ohm loads.
NEW! 2004
Cat. AA-0415 **$99.95**

Secure Clip-On Earphones

Won't fall out when you're jogging! They are comfortable to wear, sound great and will give you hi-fi performance from the Neodymium speakers. 3.5mm stereo plug.
NEW! 2004
Cat. AA-2023 **$12.95**

Dummy House Alarm

Make your house look alarmed!
It includes a siren cover, strobe, and three warning stickers. It looks just like the real thing, at a fraction of the price.
Cat. LA-5130 **$47.50**

Melcom 5 Sector Alarm with Built-In Keypad Deal

A great system from Melcom!
The LCD keypad and 'brains' have been combined into the one unit for easier installation and operation. It offers a host of great features, as you would expect from Melcom. The kit includes all the parts you need to get setup. See our website for full details.
Cat. LA-5435 **$369.00**

Two Way Paging Car Alarm

Keep an eye on your car all the time!
Includes black box controller, two transmitter keyfobs, foot brake trigger, car transmitter, shock sensor, ignition cut out relay, bonnet pin switch, battery backup siren, and wiring. **Was $349**
SAVE $50
Cat. LA-9010 **$299.00**

NEW HARDCORE ELECTRONICS!

This section is dedicated to what's new for the Hardcore Enthusiast.

A LONG LOST TREASURE! HKZ-101 Hall Effect Vane

NEW! 2004

Jaycar has it back!

Previously obsolete, the HKZ-101 has been commonly requested, but difficult to find since Siemens deleted it in 1998. This copy is almost identical, and works very well. See our website for data.

Cat. ZD-1900 $19.95

F Type Waterproof Crimper

NEW! 2004

For use on waterproof crimp connectors.

Suits RG-59 (4C), RG-6 (5C), F, BNC, and RCA connectors.

Cat. TH-1802 $79.95

Waterproof F Crimp Connector

NEW! 2004

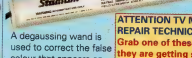
Waterproof F-81 line plug, compression type.

Cat. PP-0670 $1.49

Stadium Double Insulated Degaussing Wand

NEW! 2004

For the serious Techie!



A degaussing wand is used to correct the false colour that appears on TVs and CRT monitors when a strong magnet (such as a loudspeaker) comes near the screen. One zap with this product and your TV/Monitor's natural reproduction is restored.

•240VAC, 1.8m mains lead.

ATTENTION TV MONITOR REPAIR TECHNICIANS
Grab one of these now as they are getting scarce!

Cat. TH-2460 $79.95

IDEAL PROFESSIONAL MULTIMETERS

A COINCIDENCE, BUT NOT A FLUKE!

IDEAL

These meters are of outstanding quality, and will rival the best of them. They come with a lifetime guarantee. As long as you own the meter, we will repair or replace the product if it becomes genuinely faulty. Beat that!

True RMS Commercial Contractor Grade DMM

- High speed analogue bargraph.
- Relative mode.
- Capacitance.
- Frequency.
- Duty cycle.
- CAT III 600V

Cat. QM-1628 $349.00

True RMS Commercial Contractor Grade Clamp Meter

- 200Amp AC current capability.
- Vibrating AC voltage detection.
- Audible dangerous voltage warning.
- CAT III 1000V

Cat. QM-1625 $449.00

See our website for a long list of features and specs.

The Practical Guide to Satellite TV

Fourth Edition

Learn all about satellite TV! It has 156 pages covering topics such as the history and evolution of satellite TV, components and dishes, encryption systems, as well as practical information on setting up satellite receivers, and data. 292 x 207mm.

Cat. BV-1800 $49.00

NEW! 2004

TDA1905 5W Audio Amp IC BARGAIN

SCOOP PURCHASE!

It is a 5W audio amplifier with an internal muting facility. 16 DIP package, data sheets are available on our website and are included with the 100 pack.

NEW! 2004

Cat. ZL-3600 $3.95 ea | Cat. ZL-3602 $34.50 pk 10 | Cat. ZL-3604 $200 pk 100

GPO Mains and Earth Leakage Tester

NEW! 2004

Make GPO installation and checking a breeze!

Identifies problems with wiring, and checks earth leakage circuit breakers using selectable trip current. A must have for electricians and handymen.

Cat. QP-2000 $19.95

Portasol Pro Piezo Gas Soldering Iron Kit

Excellent versatility!

It features a variable tip temp up to 580°C, 15-75W equivalent power, and around a 45min run time. Internal piezo ignition.

Cat. TS-1318 $119.00

1000V 7 Piece Screwdriver Set

GS and VDE tested and approved.

Soft rubber grip handles, with insulation right to the tip.

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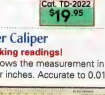

Cat. TD-2022 $19.95

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NEW! 2004

Add green power to your devices!

Just crank the handle for power. It can easily be adapted for use in low current projects and devices. Crank slowly, and the voltage is low. Crank fast, and the voltage is high. See website for details.

Cat. HD-7000 $14.95

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A great way to start!

It includes a Duratech 25W soldering iron, quality metal stand and sponge, a length of solder, and a de-soldering wick.

Cat. TS-1650 $24.95

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Cat. TD-2082 $79.95

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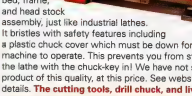

Cat. TL-4000 $899.00

Non-Contact Digital Thermometer with Laser Sighting

Extremely versatile!

Now there is no need to touch the object you would like to take the temperature of. Simply point and pull the trigger to take the surface temp quickly and easily.

Cat. QM-7222 $149.95

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Cat. QC-1910 $379.00

Driveway Automatic Entry Sensor Kit

EXCLUSIVE to JAYCAR!

Ref: Silicon Chip Nov 2004. Automatically open your electronic gates or automatic garage door as you approach in your vehicle, without the use of remote controls! It uses a large coil sensor to detect moving metal (eg a car chassis), which reduces false alarms from animals and people etc. Kit supplied with PCB, silk screened machined case, pre-wound and insulated 5000 turn coil, and all electronic components.

NEW KIT

Cat. KC-5402 **$179.00**

USB Mains Board Switch Kit

Automatic peripheral switching!

NEW KIT

Ref: Silicon Chip Nov 2004.

This project allows you to have your peripheral devices switch automatically when you switch on your USB equipped PC. It will fit INSIDE many power boards, so you won't even know it's there! Kit includes PCB & all electronic components.

Requires a mains powerboard.

Cat. KC-5401 **$19.95**

Luxeon Star LED Driver Kit

Power 1W, 3W, and 5W Luxeon LEDs from a 12V source!

Ref: Silicon Chip May '04. Save $$$ off purchasing pre-built drivers. Kit includes PCB, and all electronic components.

Cat. KC-5389 **$29.95**

Video Enhancer and Y/C Separator Kit

NEW KIT

Convert composite video to S-Video and enhance it!

Ref: Silicon Chip August 2004. Planning to transfer your VHS videos to DVD with your computer? This project enhances & sharpens the picture, as well as converting to S-Video for a high quality transfer! Kit supplied with through-hole plated and solder masked PCB, case, silk screened and laser cut panels, quality Belden RG58 cable, mains plug pack, and all electronic components.

Cat. KC-5394 **$179.00**

The Jaycar kit is supplied with genuine Belden RG58 A/V cable. This cable has a known, consistent propagation delay so you can be confident the propagation delay will be spot on. Beware of inferior kits that use cheap "house" brand cable that might have wildly variable propagation delay characteristics.

USB Power Injector Kit

NEW KIT

A power boost for your USB port.

Ref: SC Oct 2004. Give your peripherals the power your PC can't supply. Kit supplied with PCB, case, silk screened and punched panels, and all electronic components.

Cat. KC-5399 **$29.95**

SMS Controller Kit

NEW KIT

Control appliances from anywhere!

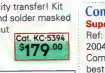
Ref: Silicon Chip Nov 2004. The SMS controller kit works with Nokia 3210, 3310, 5110, and 6110 models to control electronic outputs, and gives you a host of control options. The possible uses are almost endless! Kit includes PCB, pre-programmed micro, and all electronic components. Requires Nokia data cable.

Cat. KC-5400 **$49.50**

Component to RGB Converter Kit

Superior video quality!

Ref: Silicon Chip May 2004. Component video is the best quality format available, but it your TV or Plasma screen etc only accepts RGB inputs? Build this unit and get the best out of your equipment. Kit includes PCB, case, silk-screened punched panels, colour coded RCA sockets, 9VAC plugpack, and all electronic components.



Cat. KC-5388 **$99.95**

Dr Video Kit MkII

NEW KIT

An even better video stabiliser!

Ref: Silicon Chip June '04. Movie companies deliberately tamper with the video signal to restrict copying. Get the picture you paid for and strip out these annoying signals from composite or S-video. Kit includes PCB, case, panels and all electronic components.

Cat. KC-5390 **$99.95**

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NEW KIT

Add an extra injector!

It can be completely programmed over the entire load range with excellent mapping resolution. Requires the KC-5386 Hand Controller for programming.

Cat. KC-5384 **$79.95**

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NEW KIT

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Cat. KC-5385 **$79.95**

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NEW KIT

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It determines how hard you have been driving, and idles the motor for an appropriate period after ignition switch off to assist in turbo cooling. Kit supplied with PCB, and all electronic components.

Cat. KC-5383 **$44.95**

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NEW KIT

Save a fortune over pre-built units!

Use it with an injector to fire nitrous fuel into your engine, or control an electronic water pump etc.Kit supplied with PCB and all electronic components.

Cat. KC-5382 **$24.95**

Independent Electronic Boost Controller Kit

NEW KIT

Superior control over the boost curve! Features two individually programmed curves for a 'wet & dry' or "street and race" type boost setup. Requires the KC-5386 Hand Controller for programming. Kit supplied with PCB, case, and all electronic components.

Cat. KC-5387 **$79.95**

Hand Controller Kit for Digital Adjusters

NEW KIT

Programming or real time display! It controls the KC-5385 Digital Fuel Adjuster, KC-5384 Digital Pulse Adjuster & KC-5387 Independent Electronic Boost Controller. Program remove or leave connected for real time display! Kit supplied with PCB, case, and all electronic components.

Cat. KC-5386 **$59.95**

Digital Speedo Corrector Kit

Re-calibrate your speedo! If you upgrade your gearbox or change diff ratios, your speedo may not read correctly. This project compensates at a programmed level, working with electronic speed sensors. Kit supplied with PCB, and all electronic components.

Cat. KC-5380 **$44.95**

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PRODUCT SHOWCASE

Prime's new LED light fittings

Prime Electronics have released a new range of "Lumiled" indoor/outdoor LED fittings designed for domestic, commercial/display, marine, mobile home and caravan applications.

The advantages of LEDs in lighting applications are becoming more and more appreciated, with long life (typical 100,000 hours), high efficiency and low power. Unlike halogen lights, LEDs are also vibration proof.

The range includes two models which are not only weatherproof (so can be used outdoors as garden lights which are becoming very popular) but are completely submersible so can be used in ponds and pools (pictured above).

One of these has a brass finish while the other is black powder-coated.

Others in the new range are virtually drop-in replacements for existing low-voltage downlights, with a 57mm ceiling cutout (MR11 size). The gimballed fittings are available in white, gold, gold/chrome and stainless steel.

All of these fittings require a 3.6V power supply which is also available from Prime Electronics.

The fittings can be inspected at Prime showrooms in Brisbane, Sydney and the Gold Coast.

Contact:
Prime Electronics
22 Campbell St, Bowen Hills, Qld 4006
Tel: (07) 3252 7466 **Fax:** (07) 3252 2862
Website: www.prime-electronics.com.au

Comsol solves the USB cable tangle

With its offer of high-speed peripherals connection, USB is fast becoming the computer interface of choice. Unfortunately, the variations in the shape and size of connectors often demands the purchase of multiple cables to interconnect various devices.

USB specialist, Comsol, has answered this problem with a neat five-in-one cable solution.

The 5-in-1 Quicklink Cable is just one cable but has five interchangeable connectors that cover the majority of peripherals found on the Australian market.

It is simply a matter of selecting the appropriate connectors for the task then plugging the devices together. The two-metre cable is fully USB 2.0 compliant, providing data transmission up to 480 Mbps, and the cable has both foil and braided shielding to reduce any chance of electrical or radio interference.

With the supplied connectors, five configurations are available:

- A Male to B Male
- A Male to A Female
- A Male to Mini B Male
- Mini A Male to B Male
- Mini A Male to Mini B Male

The Quicklink kit fits into a carrying pouch which can be carried in a notebook case.

With a suggested retail price of $29.95 and covered by a lifetime warranty, the 5-in-1 Quicklink Cable is available from leading accessory retailers.

Contact:
Comsol Pty Ltd
PO Box 570 Sydney Markets NSW 2129
Tel: (02) 9701 8800 **Fax:**(02) 9701 8811
Website: www.comsol.com.au

MicroZed staging PICAXE Fair

Australian distributors of PICAXE products, MicroZed, will celebrate the amazingly versatile devices' second anniversary in Australia with a PICAXE Fair to be held in Sydney on Friday, December 10.

The fair will run from 10am to 5.30pm in the Concord RSL Club auditorium, which is a 10-minute walk from Concord West railway station.

Several international guests will be attending the fair, including the "father" of the PICAXE, Clive Seager; SILICON CHIP PICAXE columnist and guru Stan Swan; and author David Lincoln. SILICON CHIP will also be represented by Editor-in-chief, Leo Simpson.

MicroZed principal Bob Nicol said that many schools and individuals are planning to bring their PICAXE projects along to show, with prized being offered for the best. Bob also invited those with unfinished or "problem" projects to bring them along too, with the opportunity of free advice and assistance from other PICAXE enthusiasts – maybe even Clive Seager himself!

For more information, visit the MicroZed website, **www.microzed.com.au** or **www.picaxe.com.au**.

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DSE <$200 Function Generator

Dick Smith Electronics have submitted their new FG-30 Function Generator for evaluation – and it shapes up as a nice instrument!

The mains-powered device offers an output of 0.5Hz to 3MHz in six steps, with sine, square, triangle, ramp, positive pulse and negative pulse waveforms (ramp and pulse waveforms to 2.5MHz).

A rotary switch controls output frequency.

Minimum and maximum outputs are 0.1V/20V peak-peak on no load and 0.05V/10V peak-peak with 50Ω load. The synchronous output is a fixed 3V peak-peak with a rise time of less than 30µS. Sweep generation is linear and log switchable with a 5s to 10ms speed, continuously adjustable, and a sweep width of 1:1 ~ 1:100. As a pulse generator it can deliver an adjustable pulse width from 100ns to 0.4s.

Stability is 0.1% after 15 minutes and 0.2% after 24 hours. Overall unit size is 275 x 90 x 300mm and it weighs in at 2.5kg. The handle tilts down to become a stand, as shown above.

With a catalog number of Q-1826, it is priced at $198.00. It is only available at DSE PowerHouse stores or through web/mail order (not stocked in "normal" DSE stores).

Contact:
Dick Smith Electronics
Reply Paid 500, PO Box 500,
Regents Park DC NSW 2143.
Tel: 1300 366 644 **Fax:** (02) 9642 9155
Website: www.dse.com.au

Altronics launches new improved website

Altronics have recently launched their new 2005 website. The new site features much improved navigation and search functions, as well as significant updates to make ordering goods easier.

The site now has full support for retail, trade, government, schools and wholesale customers. Pricing and quantity breaks are all tailored for every customer's particular requirements.

The new search function has been totally re-written allowing customers to receive more effective keyword results, plus search by brand name or catalog index entry.

In addition, Altronics have increased the size of all product images for easier viewing, added hundreds of new downloadable brochures & manuals and re-categorised thousands of products ensuring it's easier to use than ever before.

Contact:
Altronics
PO Box 8350, Perth Business Centre 6849
Tel: (08) 9528 2199 **Fax:** (08) 9428 2198
Website: www.altronics.com.au

Keeping TVs out of landfill: new TV recycling organisation formed

Keeping old TV sets out of landfill is now a major environmental objective for industry.

The Consumer Electronics Suppliers' Association (CESA) has established Product Stewardship Australia Ltd, a not-for-profit company that will manage and promote the disposal and recycling of TVs in an environmentally sound manner.

It is an industry-led initiative that will divert thousands of tonnes of TVs from landfill each year. It also reflects industry's commitment to an environmentally sustainable future. Initial focus will be on a phased national scheme that will see the collection and recycling of televisions commencing in major capital cities, extending later to other cities and regions.

Product Stewardship Aust is currently seeking membership from industry. All suppliers of TVs are encouraged to be socially responsible and commit to the new company.

Contact:
Product Stewardship Aust Ltd
Tel: (02) 6247 4655
email: bdouglas@aeema.asn.au

SILICON CHIP WebLINK

How many times have you wanted to access a company's website but cannot remember their site name? Here's an exciting new concept from SILICON CHIP: you can access any of these organisations instantly by going to the SILICON CHIP website (siliconchip.com.au), clicking on **WebLINK** and then on the website graphic of the company you're looking for. It's that simple.

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JED designs and manufactures a range of single board computers (based on Wilke Tiger and Atmel AVR), as well as LCD displays and analog and digital I/O for PCs and controllers. JED also makes a PC PROM programmer and RS232/RS485 converters.

Jed Microprocessors Pty Ltd
Tel: (03) 9762 3588 Fax: (03) 9762 5499
WebLINK: jedmicro.com.au

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Want to set up a wireless hotspot?

If you run a pub, motel, restaurant, VIP lounge or coffee shop, business service center, conference room or similar and want a small business on the side . . . or maybe you are simply feeling altruistic and want to give mobile computer users access to the 'net, MicroGram has the perfect product for you. It's specially designed for a Hotspot environment, integrating access control and wireless network access into one system to fulfill the needs of a Hotspot.

The 11451 can immediately achieve compatibility with the current network configurations, making it the ideal choice for any WLAN infrastructure owner.

It supports 802.11b and 802.11g modes and it incorporates convenience, efficiency and other useful characteristics that users of wireless hotspot services are looking for.

A thermal receipt printer (not included) can be attached to the unit to print out users' account details, usage, login details etc.

The Cat 11451-13 Wireless Hotspot has a recommended retail price of $1199.00 and is available direct from MicroGram Computers.

Contact:
Microgram Computers
1/14 Bon Mace Cl, Berkeley Vale 2261
Tel: (02) 4389 8444 **Fax:** (02) 4389 8388
Website: www.microgram.com.au

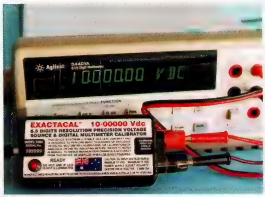
Techtime 10V DC portable calibrator has 6.5 digits resolution

One of the most frequently used multimeter scales is the 0-20V DC range. In many industries such as IT servicing, battery recharging equipment, auto-electrical, process control, medical and telecoms equipment, the need for an accurate reading result is of great importance to the technician, for aiding diagnosis, or to assist with critical adjustments related to the equipment performance or output.

Usually the voltage measuring instrument used for setting such critical parameters is calibrated by a recognised Test & Measurement Laboratory, and a Calibration Report of the multimeter or indicating meter is then issued. The report will also recommend the calibration interval, or "due date" for the next calibration – usually 12 months in most cases. Depending on the type of meter or indicator this can cost from around $200 to $400 for each calibration – quite an annual outlay for a company that may have 10-20 or more field or service technicians, each one requiring a calibrated multimeter.

A Sydney company, Techtime, are manufacturing in Australia a certified portable 10V DC Calibrator that will permanently eliminate calibration costs of 10V DC and/or 20V DC scales.

Applications include the calibration of analog and digital multimeters (3.5 – 6.5 digits), indicating meters (analog or digital), a precision reference for AD-DA 8,10, 12,14 and 16-byte converters and checking of multimeters and indicating meters within calibration intervals. It suits auto-ranging digital or switched-range digital/analog meters.



It can be run from a 240V AC plugpack, or for field use from a vehicle 12V cigarette lighter socket, or from a 12V SLA Battery. As the circuitry used in this device is far more stable, in terms of drift, than any production digital multimeter, it is possible to carry out many thousands of highly accurate calibrations for the cost of only the initial purchase price.

A multimeter connection lead (banana plugs to banana plugs) are included, as are a 240-12V approved plugpack, an owner's operation manual and a calibration certificate, traceable to the Australian National Measurement Institute (or Telarc NZ).

The Techtime 1065 Calibrator is only available direct from the manufacturer. For an Adobe PDF which includes specifications and ordering information, email your request.

Prices are $375 (inc GST) with a NATA Certificate, or $300 with a Techtime Factory Certificate.

Contact:
Techtime
PO Box 252, Roselands NSW 2196.
Tel: (02) 9759 4466
email: peterwun@bigpond.net.au

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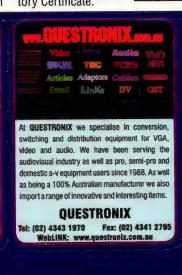

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Solar-powered wireless weather station

Based on the popular PICAXE processor, this simple weather station will "wirelessly" transmit temperature and humidity data to a receiver up to 200m away. Build one for your backyard.

By NENAD STOJADINOVIC

This view shows the completed Weather Station board (bottom) with its companion Radio Modem Transmitter board connected.

THE RADIO MODEMS presented in the November 2003 and May 2004 issues have proved to be very popular and it's been an education to see some of the uses they have been put to. One of the most common FAQs concerned the monitoring of weather, so in response to what is clearly a widespread fascination, I've decided to produce a simple weather station design.

Educational value was a major consideration, so I decided that the best arrangement would be to have a PICAXE-18A handling all of the smarts. This would be followed by a serial data modem (from the November 2003 issue) that simply relayed the various readings to a receiving station, where they could be displayed. The avid experimenter or student would then be able to poke around the sample code to their heart's content, secure in the knowledge that they don't have to worry about messing up a complex RF data link.

A computer is one of the easiest ways to present the readings, so the results go into the COM port of an old IBM-compatible running Hyperterminal. Fig.1 shows the basic layout.

And now the weather

The PICAXE takes a reading from a Dallas DS18B20 temperature sensor and a humidity reading from a Honeywell HIH-3610-001. The readings are processed and loaded into the modem transmitter, together with information to make it more easily readable by the user. In the example program listing, the PICAXE loads bytes that correspond to "T = " before loading the temperature value and "RH% = " before the humidity.

The receiver will then simply print the received bytes onto the screen resulting in, say, *T = 24, RH% = 64*. As an added refinement, I have fo... up the data with a separat... sion that sends an <en...

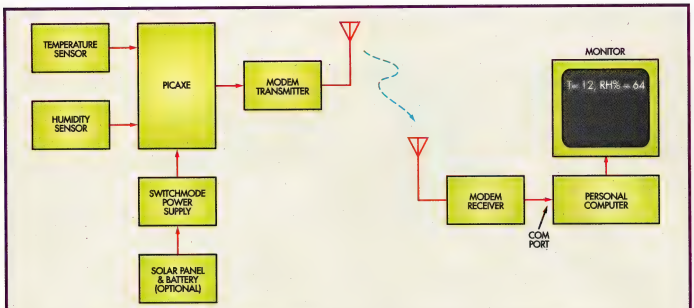


Fig.1: block diagram of the Weather Station. It uses a PICAXE microcontroller to monitor temperature and humidity sensors and this then drives a Radio Modem Transmitter (described in November 2003). The RF signal is picked up at the receiving station, decoded and fed into a PC which displays the data.

(line feed) command so that you end up with a neat list of readings down the lefthand side of the screen. Why a separate transmission? Because the modem accepts only 16 bytes at a time and by the time you've loaded T<space> = <space>, etc, there isn't room for the <enter> and <LF>.

Speaking of refinements, I've designed in an elegant switchmode power supply from the clever people at Maxim. Based on the MAX757, it will accept any voltage between about 0.5V and 5V and turn it into a stable 5V. Not only can you use a 1.5V battery rather than an expensive 9V type, you can also use a solar cell and Nicad battery for "eternal" power.

As shown in the photos, my version was built into a cheap solar garden light, currently being sold just about everywhere in almost any form you can imagine.

Using garden lights was a real boon, especially as they can be found for around $10. The innards consist of a solar cell charging a Nicad battery through a diode, followed by a simple circuit that switches the LED on at sunset. Conversion consists of evicting the original circuit board and wiring the weather station in its place.

General arrangement

The weather station is in the form of three separate logical building blocks. First, let's look at the power supply which is a DC-DC switchmode converter operating in boost mode – see Fig.2. Current from the low voltage supply flows through inductor L1 and into pin 8 of the MAX757. The boost effect relies on the fact that the current in a coil is slow to start flowing and equally slow to stop once it does – think of it as an electronic version of a flywheel. The current is allowed to get up to a good clip and then pin 8 suddenly switches it off.

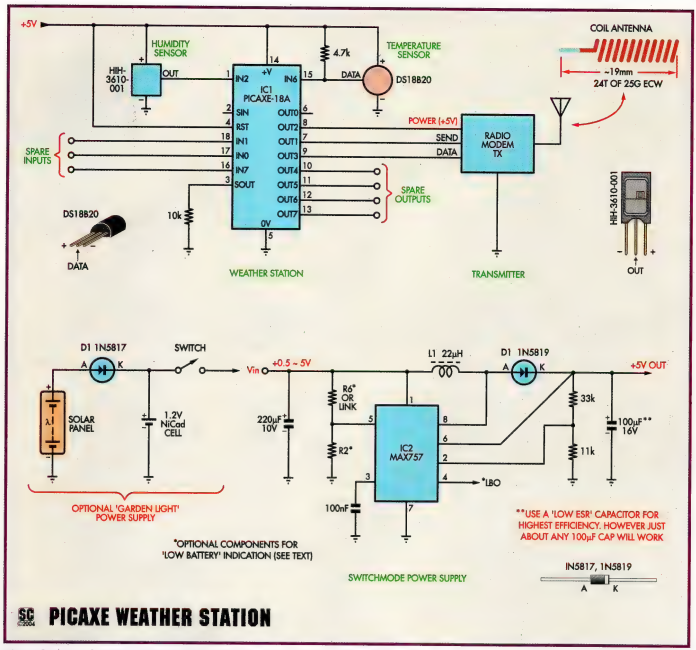
The energy in the coil then has nowhere to go except through diode D1 and into the 100µF storage capacitor – think of the capacitor as a water tank. The clever part is that the final voltage on the 100µF capacitor can be controlled by varying the ratio of the on to off times of pin 8. Pin 2 monitors the voltage output and it is compared to a reference voltage generated by a potential divider made up of the 33kΩ and 11kΩ resistors.

The MAX757 also has provision for a low voltage warning at pin 4. I haven't used it in the weather station but have provided for the possibility. Thus, R2 is deleted and a wire link is put in place of R6.

The PICAXE is the heart of the circuit. The temperature sensor outputs a digital signal which is read by a PICAXE command specifically designed for this particular sensor, called "READTEMP". The humidity is handled by an A/D conversion followed by a mathematical equation that is evaluated by the PICAXE to arrive at a humidity reading from 0-100%.

It is important to note that both of the readings are heavily processed to turn them into something that can be read by people. For example, the temperature sensor is itself controlled by its internal microprocessor and the PICAXE must establish communications, download the temperature reading (in a special format), convert it to a more human readable form and then finally convert it to the ASCII format

The circuit is built into a low-cost solar-powered garden light and is powered from the existing solar cell and Nicad battery.



SC PICAXE WEATHER STATION

Fig.2: there are basically three parts to the circuit: (1) the weather station circuitry consisting of PICAXE IC1 and the humidity and temperature sensors; (2) a radio modem transmitter; and (3) a simple switchmode power supply.

which computers use for display purposes.

The radio modem then has the simple job of taking the resulting data and making sure it arrives at the computer's COM port in good order, exactly as a good post office does.

There is an unusual feature in that the modem is actually powered by the PICAXE!

Construction

Start the construction by building the power supply section only, taking extra care to correctly orient the capacitors and diode. Once it's finished, connect a 1.5V battery and measure the output at pin 6; it should be very close to 5V.

Next up is the modem, which is assembled as per the included instructions. You will be making life hard for yourself if you don't test the modem before use – this is most easily done by soldering a temporary link between the SEND pin and ground. Plug the receiver into your computer, fire up Hyperterminal at 1200 bits/sec and apply 5V to the transmitter. If you get a neat series of '012345678:;<=>' then you can be fairly sure the modem works. If it does, remove the temporary link and put the modem aside.

Next, solder in the two sensors and put the programmed PICAXE into its socket, then solder in the modem. Apply power – if all is well, you will get a line on your screen with the temperature and humidity, followed a short time later by a line feed.

If not, the first thing to check is the power and control lines to the modem transmitter. The power is supplied by pin 8 of the PICAXE and SEND is controlled by pin 7. Power should of course sit at 5V and the SEND pin should blip down to 0V twice every 15 seconds or so. Data is supplied to the modem via pin 9 and you should see

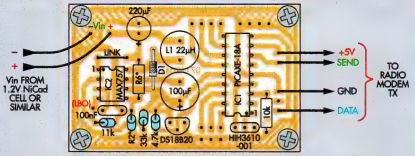
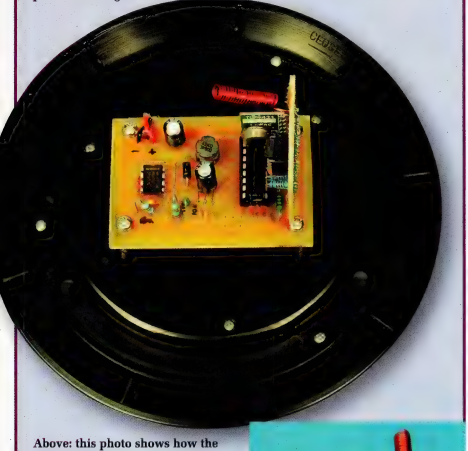
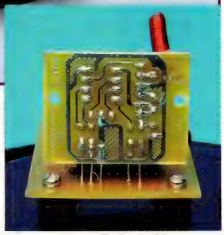


Fig.3: follow this wiring diagram to assemble the Weather Station PC board. The Radio Modem Transmitter board can be mounted at right angles on this board and connected using tinned copper wire links – see photo below right.



Above: this photo shows how the board assembly is mounted on the bottom of the plastic solar-cell housing.



two brief "blurts" of data at the same 15-second repeat rate.

If you get lines of data on your screen but the temperature or humidity value is wrong or non-existent, check the orientation and electrical integrity of the sensors.

For the experimenter

I have included several features to more easily adapt the weather station to various tasks. Probably the most important is that the PICAXE powers the modem, specifically intended for low-power operation. The PICAXE

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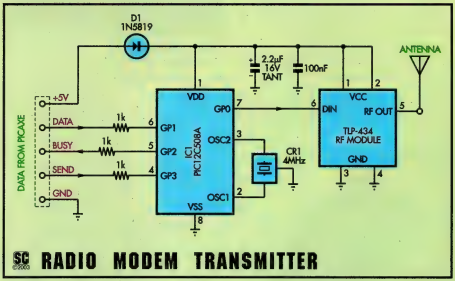


Fig.4: reproduced from the November 2003 issue, this diagram shows the Radio Modem Transmitter (Tx) circuit. IC1 (an 8-pin PIC microcontroller) receives serial data – in this case from the PICAXE on the Weather Station PC board – and then sends it to the receiver via a UHF transmitter module.

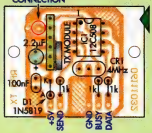


Fig.6: parts layout for the Radio Modem Transmitter PC board.

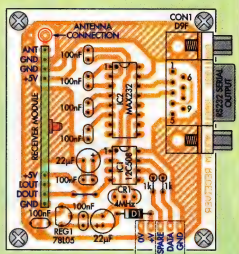


Fig.7: parts layout for the Radio Modem receiver board.

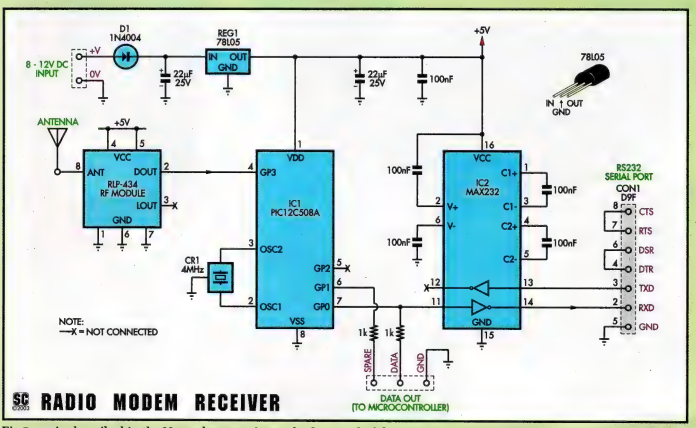


Fig.5: again described in the November 2003 issue, the front end of the receiver circuit is almost a mirror image of the transmitter. PIC microcontroller IC1 receives data from the UHF receiver module and – after decoding and error checking – passes it on to the PC's serial port via a MAX232 receiver/driver chip (IC2). The optional external DATA output is not used for the Weather Station.

Parts List

1 Toko 22µH inductor (494LYF-0084M)
1 PC board, code 07112041, 61 x 39mm
1 18-pin DIL IC socket

Semiconductors

1 1N5819 Schottky diode (D1)
1 PICAXE-18A microcontroller (IC1)
1 MAX757CPA DC-DC converter (IC2)
1 Dallas DS18B20 smart temperature sensor
1 Honeywell HIH-3610-001 humidity sensor
1 Radio modem Tx/Rx pair

Capacitors

1 220µF 10V electrolytic
1 100µF 16V low ESR electrolytic*
1 100n (0.1µF) monolithic (code 100n or 104)

Resistors

1 33kΩ 1 10kΩ
1 11kΩ 1 4.7kΩ
R2 – optional, see Fig.3
R6 – wire link, see Fig 3

* A low ESR capacitor will give fractionally higher conversion efficiency; they can be found at Altronics and Jaycar. I personally don't bother and just fit an ordinary capacitor.

demo code transmits readings every 15 seconds or so and metaphorically drives around in circles in between times.

Low power operation

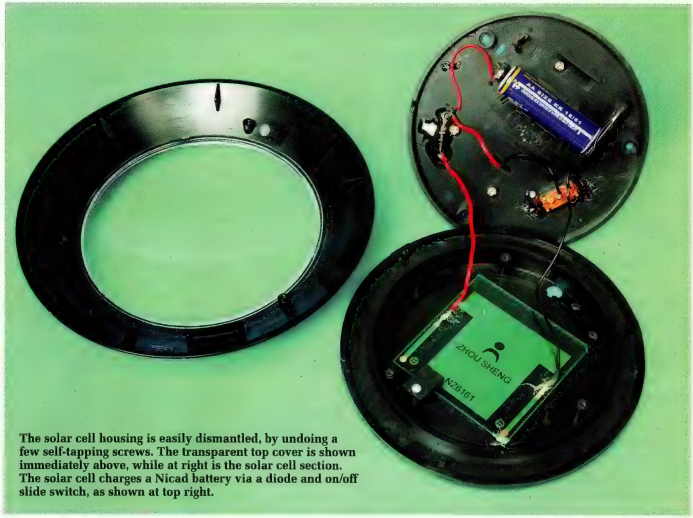
Low power operation usually requires that the transmitter power is turned off (by pulling pin 8 low) and the PICAXE is put to SLEEP between transmissions. You may also find that 15 seconds is too short a time between transmissions for the battery to maintain and so the PICAXE may need to sleep for, say, five minutes at a time.

There are several extra inputs and outputs on the board, perfect for extra tasks such as reading rainfall or solar radiation, turning on fans, etc. If a common theme emerges, I may develop some extra modules to plug into the basic unit.

As mentioned, the MAX757 DC-DC

Demonstration PICAXE Program

```
; DEMO.BAS by Nenad Stojadinovic

; This software is freeware and may be freely distributed

; This software is written for the PICAXE 18A or 18X and reads temperature from
; a Dallas Semiconductor DS18S20 and relative humidity from a Honeywell
; HIH-3610 sensor. Either the temperature or humidity section of the program can be
; used on its own, just cut out the bit you don't need. Likewise the screen control
; section can be modified or cut out for use on LCDs.

; The temp and RH data is converted to ASCII and sent out at 1200 baud (N,8,1).
; Provision is made to control a radio modem transmitter, as detailed in Silicon Chip,
; Nov 2003. Output pin OUT 3 remains high until all sensor data is accumulated by the
; PICAXE and then it is pulled low for 100ms to trigger a radio transmission. Email to
; vladimir@u030.aone.net.au for more information.

; This software is based on articles originally published in Silicon Chip, Nov 03 and
; March 04.

; OUT 3 connected to the transmitter's DATA line (high when idle)
; OUT 2 connected to the transmitters POWER input
; OUT 1 connected to the transmitters SEND line (high when idle)
; DS18B20 temperature sensor connected to IN 6
; Honeywell HIH-3610-001 relative humidity (RH%) sensor connected
; to IN 2 which makes an A/D conversion of the sensor voltage

; NOTE 1: putting the "#" before the register transmits the data in ASCII format
; that is suitable for computer comms progams (eg, Hyperterminal) or LCD displays
; such as the AXE 033.

; NOTE 2: This program sends a comma (44) after the temperature and a line feed (10)
; and carriage return (13) after the humidity. You can change this to anything you like,
; and you can also delete the 'T = ' and 'RH = '. For example, you might like to log the
; temp and RH over a period of time and this is easily done using MS Excel by reading
; in the received data as comma separated variables (CSV).

; NOTE 3: The humidity sensor relies on a very accurate 5V power supply. Test the
; sensor by breathing on it – if it goes over 100% RH,check the power supply voltage
; or adjust the equation (see the SC article in Nov. 04). Note though that humidity
; sensors are not all that accurate – a few percent variation is considered very good.

        high    3                       ;Initialise DATA line
        high    2                       ;Initialise POWER line
        high    1                       ;Initialise SEND line
        wait    1                       ;Wait for it all to settle

main:
        readtemp 6,b1                   ;Read the sensor, store in b1
        if      b1 > 127 then neg       ;Is temperature negative?
        serout  3,t1200,("T = ",#b1,44) ;Send the temperature stored in b1
        goto    humid                   ;Finished sending positive temp

neg:
        let     b1 = b1 - 128           ;Adjust negative value
        serout  3,t1200,("T = -")       ;Send a minus sign
        serout  3,t1200,(#b1,44)        ;Send the temperature stored in b1

humid:
        readadc 2,b2                    ;Read the humidity, store in b2
        let     b2 = b2-41*100/157
        serout  3,t1200,("RH% = ",#b2)  ;Send the humidity stored in b2

        low     1                       ;Lower SEND line to transmit
        pause   100                     ;Wait a bit
        high    1                       ;Put the SEND line back to idle

        wait    2                       ;Wait for trans to finish
        serout  3,t1200,(10,13)         ;Screen control characters
        low     1                       ;Lower SEND line to transmit
        pause   100                     ;Wait a bit
        high    1                       ;Put the SEND line back to idle

        wait    15                      ;Wait 15 seconds

        goto    main                    ;Do it all again
```



The solar cell housing is easily dismantled, by undoing a few self-tapping screws. The transparent top cover is shown immediately above, while at right is the solar cell section. The solar cell charges a Nicad battery via a diode and on/off slide switch, as shown at top right.

converter has a low-voltage indicator built in and this is implemented using optional resistors R2 and R6. If you want to use it, it's simply a matter of downloading the data sheet from Maxim and then following the instructions.

Antennas

I have found that the best antenna for the buck is a simple length of insulated wire. Just cut it to 165mm and solder it on – no adjustment is necessary. In my case, it was possible to feed the antenna down into the plastic garden light post and I found that the range was excellent.

For those who want to build the transmitter into a smaller space, a coil antenna may be more appropriate (see photo). It simply consists of 24 turns of 25-gauge enamelled copper wire wound onto a 3mm drill bit, with a total length of about 19mm (see photo). It will need to be adjusted by stretching out or compacting the coils until you get adequate range (remember that radio spectrum users consider it impolite to blast out more power than you need, even at the low levels we are generating). Note, however, that you will never get the range of the simple piece of wire.

If you need a professional appearance or real range, you can't go past the rubber duck antenna featured in the previous articles. **SC**

Where To Get The Parts

Kits plus individual parts for this project are available from the author. Prices are as follows:

(1). Weather Station PC board plus switchmode supply components.....$28.50
(2). Add PICAXE-18A $10.50
(3). Add DS18B20 temperature sensor.....$6.00
(4). Add HIH-3610-001 humidity sensor.....$35.00
(5). Package deal of Tx/Rx modem plus Weather Station PC board plus switchmode power supply components.....$93.00

All prices include postage within Australia and GST. To order, write or email the author as follows:

Nenad Stojadinovic, PO Box 320, Woden, ACT 2606.
email: vladimir@u030.aone.net.au

Note: please contact the author before ordering as prices are very volatile (eg, the humidity sensor has gone up by 400% in the last year)!

BIDIRECTIONAL MOTOR SPEED CONTROLLER

This project allows you to control the speed of a DC motor in both forward and reverse direction, from fully off to fully on. It can be used for motors running at 12V or 24V and drawing up to about 5A. It runs in switchmode so it is quite efficient.

While we have published a number of DC speed control circuits over the years, none has had the ability to control speed over the full range in both forward and reverse (with the exception of the Bi-directional Train Speed Control in the April 1997 issue of SILICON CHIP).

We have published a very popular 12V/24V 20A switchmode speed control (June 1997) but it works in only one direction. If you want it to change direction, you need a double-pole changeover switch or relay to change the polarity of the applied voltage and the motor spins the other way! However, this has the disadvantage that you then have two things to control the motor – a direction switch as well as the speed control.

Also, it is not a good idea to suddenly reverse the voltage on a DC motor while it is spinning. It can cause a big current surge that could burn out the speed controller, as well as causing big electrical and mechanical stresses on the motor itself.

Design by FRANK CRIVELLI

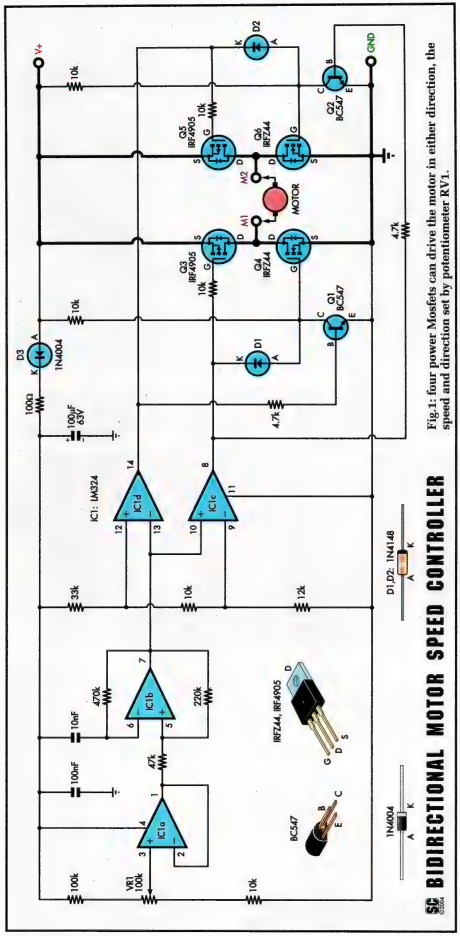


Fig.1: four power Mosfets can drive the motor in either direction, the speed and direction set by potentiometer RV1.

This circuit overcomes both these problems. The direction and speed is controlled using a single potentiometer. Turning the pot in one direction causes the motor to start spinning. Turning the pot in the other direction causes the motor to spin in the opposite direction.

The centre position of the pot is the "off" position, forcing the motor to slow and stop before changing direction.

Specifications

Voltage: both the control circuit and the motor use the same power supply. And while the maximum operating voltage of the LM324 is 32V DC we would suggest the maximum operating voltage of the circuit is 24V DC, as supplied by a 24V battery. In practice, this means that the supply could be almost 29V.

Any more than this means that there is very little safety margin (ie, below the maximum of 32V).

Current: the IRFZ44 Mosfet can handle 49A and the IRF4905 can handle 74A. However, the copper tracks on the PC board that run from the Mosfet pins to the screw terminal block can only handle around 5A and the same goes for the terminal block itself. This could be increased by soldering wire links along the copper tracks and bypassing the terminal blocks with direct wire connections.

If you do this, then the circuit can probably handle up to 10A or so. Check that the Mosfets don't get too hot – if so, then bigger heatsinks will be required.

In any case, the gate drive to the Mosfets does not ensure a fast enough switching speed to handle really high currents.

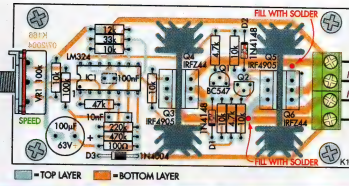
Speed control of DC motors

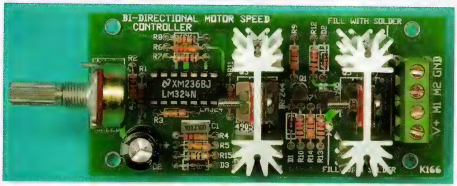
In essence, there are four ways to vary the speed of DC motors:

1. By using mechanical gears to achieve the desired speed. This method is generally beyond the capability of most home workshops.

2. Reducing the motor voltage with a series resistor. However this is inefficient (energy wasted in resistor) and reduces torque.

The current drawn by the motor increases as the load on the motor increases. More current means a larger voltage drop across the series resistor and therefore less voltage to the mo-





At top is the PC board overlay (Fig.2) with a matching assembled board underneath. Note the comments about the Mosfet/heatsink assembly: don't rush in and solder the Mosfets in place! Also note the two vias which must be filled with solder.

tor. The motor now tries to draw even more current, resulting in the motor "stalling".

3. Using a transistor to continuously vary the voltage to the motor. This works well but a substantial amount of heat is dissipated in the power transistor.

4. By applying the full supply voltage to the motor in bursts or pulses, eliminating the voltage losses in the series resistor or transistor. This is called pulse width modulation (PWM) and is the method used in this circuit. Short pulses means the motor runs slowly; longer pulses make the motor run faster.

How it works

The circuit of the speed controller is shown in Fig.1 and essentially consists of an LM324 quad op amp and four Mosfets in a bridge configuration to drive the motor.

Let's start with the motor drive section, based around the four Mosfets Q3-Q6. Only two of these Mosfets are on at any one time.

When Q3 and Q6 are on, current flows from Q3 through the motor to Q6 and it spins in one direction. When Q4 and Q5 are on, the current flow is reversed and the motor spins in the opposite direction. Op amps IC1c and IC1d control which Mosfets are turned on.

Op amps IC1c & IC1d are connected as a "window comparator". Pin 12 (non-inverting input) of IC1d and pin 9 (inverting input) of IC1c are connected to a resistor voltage divider of 33kΩ, 10Ω and 12kΩ. Therefore IC1d's output goes low if its inverting input (pin 13) is taken above pin 12 while IC1c's output goes low if its non-inverting input (pin 10) is taken below pin 9.

Op amp IC1b is connected as a triangle wave generator and it provides the control signal for the voltage comparators. It runs at about 270Hz, as set by the 10nF (.01µF) capacitor and 470kΩ resistor connected to pins 6 & 7. The peak-to-peak amplitude of the triangle wave is less than the difference between the two voltage references applied to pins 9 & 12.

Therefore it is impossible for both comparators to be turned on simultaneously; only one comparator can turn on at any time. Otherwise all four Mosfets would conduct, causing a short circuit that would destroy them.

The triangle waveform can be raised or lowered by speed potentiometer VR1 and op amp IC1a which operates as a voltage follower. Shifting the triangle wave up causes comparator IC1d to turn on (its output goes low); shifting the triangle wave down causes comparator IC1c to turn on (its output goes low). At other times, both comparator outputs are high.

Turning the Mosfets on

When IC1c's output (pin 8) goes low, it pulls the gate of P-channel Mosfet Q3 low, turning it on. The base of NPN transistor Q2 goes low as well. This turns Q2 off and allows the gate of N-channel Mosfet Q6 to be pulled high. So both Q3 and Q6 are turned on, allowing current to flow through the motor in one direction.

At the same time, pin 14 of IC1d is high, which keeps Q1 turned on, and Q4 and Q6 off. While ever the triangle output of IC1b is lowered, pin 8 of IC1c will be pulsing low at 270Hz, and thus supplying switchmode power to the motor.

Alternatively, when the triangle output of IC1b is raised, IC1d's output will be pulsing low at 270Hz, turning on Q4 and Q6 to drive the motor in the other direction.

At the same time, pin 14 of IC1c will be high, which keeps Q2 turned on, and Q3 and Q5 off.

The oscilloscope waveforms of

Parts list – K166

1 PC board, code K166, 93 x 42mm
1 IC socket, 14 pin (for IC1)
2 2-way screw terminal block (joined to make a 4-way block)
2 heatsinks for Mosfets
2 3 x 8mm screws and nuts

Semiconductors
1 LM324 Quad op amp (IC1)
1 BC547 NPN transistors (Q1,Q2)
2 IRFZ44 N-channel power Mosfets (Q4,Q6)
2 IRF4905 P-channel power Mosfets (Q3,Q5)
2 1N4148 small signal diodes (D1,D2)
1 1N4004 power diode (D3)

Capacitors
1 100µF 63V electrolytic
1 100nF polyester
1 10nF 63V polyester

Resistors (0.25W carbon film)

1 470kΩ	1 220kΩ	1 100kΩ
1 47kΩ	1 33kΩ	1 12kΩ
6 10kΩ	2 4.7kΩ	1 100Ω

1 100kΩ potentiometer, PC-mounting

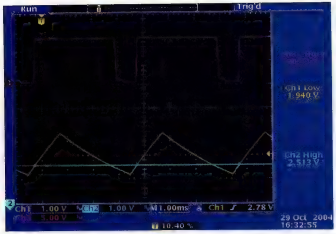


Fig.3: waveforms at the inputs (blue and yellow traces) and output (magenta trace) of IC1c. While ever the valleys of the triangle wave on pin 10 (yellow) are below the reference voltage on pin 9 (blue), the comparator's output (magenta) will be low, powering the motor via Q3 & Q6 for a portion of each cycle.

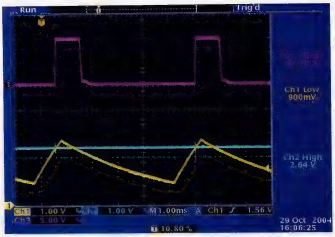


Fig.4: here we can see what happens when the pot is wound downwards to increase motor speed. The triangle wave falls further below the reference voltage, which in this case results in the motor being powered for about 80% of the time.

Figs.3-8 illustrate the operation of the circuit. Fig.3 shows the waveforms at the inverting input (blue trace), non-inverting input (yellow trace) and output (magenta trace) of IC1c.

As you can see, the valleys of the triangle waveform on pin 10 dip below the DC reference voltage on pin 9. While ever the the valley voltage is below the reference voltage, the comparator's output will be low, powering the motor via Q3 & Q6 for some portion of the cycle. In this example, the motor is powered for about 20% of the time.

Winding the pot down decreases the DC bias applied to IC1b, which in turn lowers the triangle wave further below the reference voltage.

The effect can be seen in Fig.4, where the valleys are now mostly below the DC reference and the motor is powered for about 80% of the time. With just a further small decrease in DC bias, the triangle wave will slip completely below the reference voltage and the motor will be on for 100% of the time.

Note that an unavoidable side effect of decreasing DC bias is a decrease in the oscillation frequency of the triangle generator. With the pot set for minimum DC bias (full speed), the frequency will be about 150Hz.

Fig.5 tells the story when the motor is driven in the opposite direction. These waveforms were captured at the inverting input (yellow trace), non-inverting input (blue trace) and output (magenta trace) of IC1d.

This time, we're interested in the peaks of the triangle wave, rather than the valleys, because the reference voltage is applied to the non-inverting input (pin 12). When the peaks of the triangle wave exceed the reference voltage, the comparator's output goes low, powering the motor via Q4 & Q5 as described earlier.

Winding the pot up increases the DC bias on the triangle wave and pushes the peaks further above the DC reference, resulting in the motor being powered for a greater portion

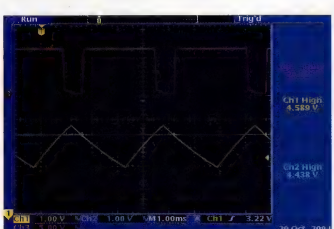


Fig.5: the second comparator (IC1d) comes into play when motor direction is reversed. Again, these waveforms were captured at the inputs (blue and yellow) and output (magenta). This time, we're interested in the peaks of the triangle wave. When the peaks on pin 13 (yellow) exceed the reference voltage on pin 12 (blue), the comparator's output (magenta) goes low, powering the motor via Q4 & Q5.

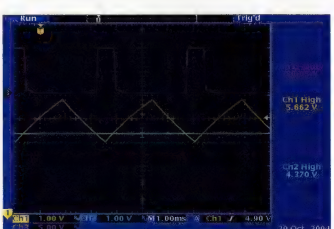


Fig.6: winding the pot up increases motor speed, as the increased DC bias ensures that the triangle wave spends more time above the reference voltage. Here the peaks are mostly above the reference and the motor is powered for about 80% of the time.

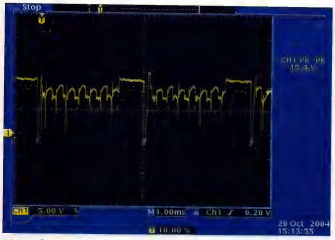


Fig.7: this waveform was captured directly across the motor terminals. The clean positive pulses are the motor on time, with the off periods composed mainly of generated hash.

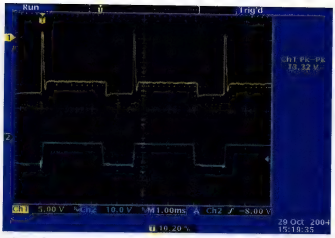


Fig.8: the top waveform here was also captured across the motor, but running in the opposite direction to Fig.6 and filtered to remove motor hash. The bottom waveform shows the signal applied to the gates of the Mosfets.

of each cycle. This is shown in Fig.5, where the motor is on for about 80% of the time.

Fig.7 shows the voltage directly across the motor terminals. The relatively clean positive pulses are the motor on time, with the intervening off periods composed of generated "hash". The top waveform in Fig.8 was also captured across the motor, but this time it's running in the opposite direction. The waveform was also averaged to remove the hash. The bottom waveform shows the signal applied to the gates of the Mosfets.

Diode D3 provides reverse polarity protection for the controller, in case the battery supply is connected the wrong way. The 100Ω resistor and 100µF capacitor form a simple low pass filter, to stop motor hash getting into the op amp circuitry.

Assembly

First, check the components supplied in the kit against the parts list. In particular, identify the IRFZ44 and IRF4905 Mosfets. They look the same so do not get them mixed.

Before mounting any components to the PC board the Mosfets must be assembled on their heatsinks.

Take one IRFZ44 and one IRF4905 Mosfet and fit them to either side of a heatsink. Loosely secure them together using the 3mm screw and nut.

The Mosfets need to be perfectly in line with the heatsink. The easiest way to do this is to mount the whole assembly onto the PC board, making sure that the heatsink pins and Mosfet leads fit into their respective holes.

Don't solder anything yet. Make sure the heatsink is sitting right down onto the PC board then tighten the screw and nut.

Repeat for the other assembly then remove the assemblies and put them aside. They will be the last items fitted to the PC board.

It is recommended that components be inserted and soldered in the following order:

1: all the resistors and diodes.

2: the 14-pin IC socket.

3: capacitor C3. This fits inside the IC socket, as far down as possible onto the PC board. If it pokes up too high it will interfere with inserting the IC into the socket.

4: transistors Q1 and Q2 and capacitor C1.

5: electrolytic capacitor C2.

6: the 2-way screw terminal blocks. These should be joined together to make a 4-way block before inserting into the PC board.

7: potentiometer VR1

8: the previously assembled heatsink/Mosfet modules. Make sure they are fitted the right way around. The IRFZ44 should be facing towards the screw terminals. Remember to solder the heatsink pins to the PC board – this is necessary for mechanical strength.

9: finally, fit the LM324 to the IC socket.

There is one last thing to do. There are two vias (pin throughs) on the PC board that need to be filled with solder so that the vias can handle the current. One is next to R13 and the other just above Q6. They are marked with the words "FILL WITH SOLDER" on the silk screen overlay.

Connecting and using

The motor connects to the **M1** and **M2** terminals. The power supply connects to the **V+** and **GND** terminals.

Providing you haven't made any mistakes on the board, it should work. Remember before you apply power to centre the pot so the motor is "off". In fact, the motor should be secured so it doesn't move around under its own torque.

Troubleshooting

If it doesn't work . . . Most faults are due to assembly or soldering errors. Verify that you have the right components in the right place.

Inspect your work carefully under a bright light. The solder joints should have a 'shiny' look about them. Check that there are no solder bridges between adjacent pads.

Check that no IC pins are bent up under the body of the IC. This can sometimes happen when inserting ICs into sockets. **SC**

Where from, how much

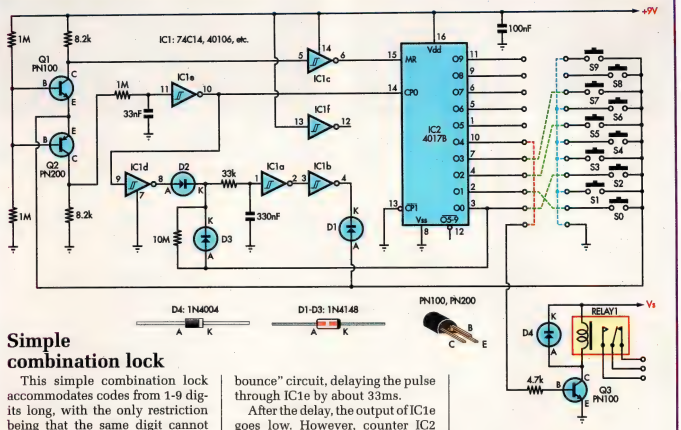
This kit was developed by Ozitronics who own the copyright on the design and PC board.

You can contact Ozitronics via their website, **www.ozitronics.com.**

The kit price is $32.50 + GST, or $35.75 inc.

CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.



Simple combination lock

This simple combination lock accommodates codes from 1-9 digits long, with the only restriction being that the same digit cannot be used twice. The circuit shows strapping for a 4-digit code, in this case "2057". Any unused switches are strapped to ground.

When power is applied, the 330nF capacitor connected to pin 1 of inverter IC1a is discharged, holding it at a logic low level. The high output is inverted by a second gate (IC1b), with the result being a logic low on pin 4. This pulls Q1's emitter low via D1, causing the transistor to conduct. The falling voltage on the collector then pulls the input of IC1c low, which in turn resets counter IC2.

On reset, output O0 (pin 3) of IC2 goes high, charging the 330nF capacitor via D2 and the 33kΩ resistor. If switch S2 is now pressed, Q2's emitter will be pulled high and so Q2 conducts, applying a rising positive voltage to one end of the 1MΩ resistor. This resistor and the 33nF capacitor act as a switch "debounce" circuit, delaying the pulse through IC1e by about 33ms.

After the delay, the output of IC1e goes low. However, counter IC2 does not increment at this stage, since it needs a positive-going edge at the clock input (pin 14). When the switch is released, Q2 turns off, IC1e's output goes high after the debounce period and the counter advances to the next state (ie. O0 goes low and O1 goes high).

When output O0 (pin 3) goes low, the 330nF capacitor starts discharging through the 33kΩ and 10MΩ resistors. This allows about 3s for the operator to press the next button. If no button is pressed within this period, IC1b's output goes low, which pulls Q1's emitter low and resets the counter via IC1c. Hence the code entry must be restarted.

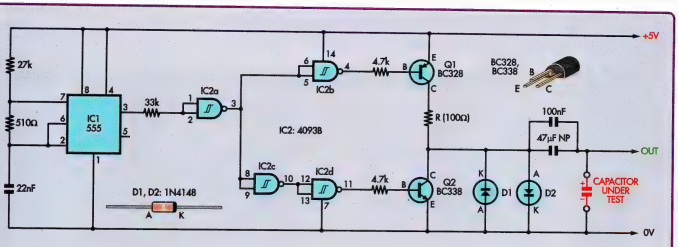
When the second digit of the code is entered (0 in this example), Q2's emitter is again pulled high. Q2 thus turns on and after the debounce delay, IC1e's output goes low. When the switch is released, Q2 turns off, IC1e's output goes high and the counter advances to state 2.

Note that while the switch is pressed, IC1d's output is high, recharging the 330nF capacitor and therefore resetting the 3s delay. Thus, the operator is allowed another 3s to press the next digit.

This process is repeated for each digit in the sequence. If the wrong switch is pressed at any point, IC2 is reset as described above. Conversely, if the correct code is entered, IC1 advances to state 4 (for our 4-digit example) on release of the fourth switch. Output O4 then goes high and turns on Q3 and relay 1.

Q3 can handle up to about 300mA of load current. If more current is required, then either a Darlington or power Mosfet can be substituted. D4 is required if the load is inductive (eg, a relay, solenoid, etc).

Len Cox,
Forest Hill, Vic. ($50)



Bare bones ESR tester

When teamed up with an oscilloscope, this simple circuit provides a means of measuring capacitor ESR.

A 555 timer (IC1) configured as a 2.3kHz free-running oscillator acts as the timebase. It provides narrow (7.7µs) pulses to the capacitor under test via a NAND Schmitt trigger (IC2) and transistor Q1.

A 100Ω resistor in series with Q1 limits current flow to about 50mA. Therefore, an ESR of 1Ω will produce pulses across the test capacitor of 50mV, which means that an oscilloscope with a vertical sensitivity of 5mV can measure ESR down to 0.1Ω or less.

Transistor Q2 discharges the test capacitor during the "off" portion of the test cycle, ensuring a zero average DC component. Diodes D1 and D2 limit the maximum output voltage to approximately 0.6V, corresponding to an ESR of 12Ω, which is adequate for most uses.

If accuracy is not critical, then the circuit could be powered from four AA batteries rather than from a regulated 5V supply.

Finally, despite building this circuit, I did invest in the ESR meter described in the March and April 2004 issues of SILICON CHIP!

Graham Jackman,
via email. ($40)

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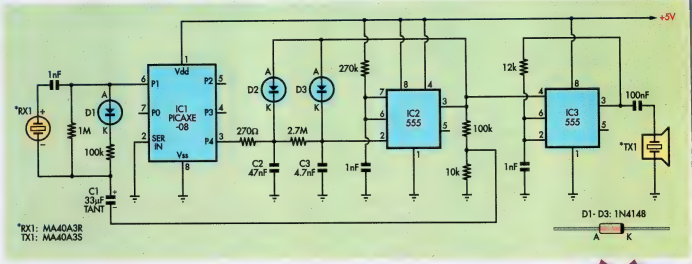


Ultrasonic rangefinder for robots

This circuit uses a PICAXE-08 as the basis of a simple ultrasonic rangefinder which has a nominal resolution of 1.7mm and a maximum practical range of about 120mm. This makes it suitable as a proximity sensor for a small robot, for example.

A novel approach is used to interface the ultrasonic receiver to the PICAXE micro, eliminating the need for any amplification, rectification, filtering or threshold detection that would typically be employed.

The PICAXE detects a signal from the ultrasonic receiver (RX1) on input 1 (pin 6). Being a digital input, at least 2V (nominal) must be applied to this pin before it will be read as a logic "high".

Pedestal voltage

In order to detect a much smaller signal level than this from the receiver, a DC "pedestal" voltage is applied to the pin, lifting it up to a value just below the logic high threshold. In this condition, even a small signal from RX1 is sufficient to exceed the threshold voltage and thus be detected by the PICAXE program.

The pedestal voltage is provided by capacitor C1, which is connected in series with the receiver. The voltage on C1 is initialised at the start of every measurement cycle using the aforementioned port pin and a simple software sequence.

First, the capacitor is charged until the voltage applied to pin 6 reads "high". This is achieved by alternately making pin 6 a high output, which charges C1 via D1 and the 100kΩ and 1MΩ resistors, and making it an input to read its logic state.

Next, the capacitor is discharged to the point where the input samples "low" 30 consecutive times, thereby minimising the chance that noise (either electrical or acoustic) will cause false triggering. This is achieved by alternately making pin 6 a low output, which discharges C1 via the 1MΩ resistor, and making it an input to read its logic state.

Once initialisation is complete, pin 6 is set as an input, ready to receive a signal from RX1. Loading of the receiver signal is kept to a minimum by the very high impedance of the digital input. In addition, any voltage produced across its terminals is too small to forward-bias D1, so the 100kΩ resistor is effectively out of circuit. A 1nF capacitor is included in series with the receiver to isolate it from the circuit's DC bias.

Transmitter

The ultrasonic frequency required for the transmit signal is generated by IC3, a 555 timer configured as a 40kHz free-running oscillator. The frequency of oscillation is set by the 12kΩ and 1nF capacitors connected to pins 2 & 6. IC3 drives the ultrasonic transmitter (TX1) via a 100nF coupling capacitor.

Andrew Partridge is this month's winner of the Peak Atlas LCR Meter

The reset input (pin 4) of IC3 is controlled by a second 555 timer (IC2). This timer is configured as a monostable, producing a 300µs wide "transmit enable" pulse as determined by the 1nF capacitor and 270kΩ resistor.

A low-going pulse on pin 3 of the PICAXE triggers the monostable, generating a 300µs transmit burst. The trigger pulse is delayed by about 5ms by an RC network, necessary because the PICAXE uses the **pulsin** command to measure the time from the trailing edge of the transmit enable signal to the reception of the first echo. This delay ensures that the trailing edge of the transmit enable signal does not occur until the **pulsin** command has been executed.

The 5ms delay works as follows: The PICAXE output on pin 3 is normally high, holding the 47nF capacitor (C2) charged via the 270Ω resistor. In turn, the 4.7nF

capacitor (C3) is charged via the 2.7MΩ resistor. This holds the trigger input of IC2 high.

The PICAXE sends a transmit burst by briefly taking pin 3 low, then setting it as an input. This discharges capacitor C2 but does not hold it discharged. C3 then slowly discharges into C2 via the 2.7MΩ resistor.

After about 5ms, the voltage on C3 falls below the 1/3 Vcc threshold of IC2's input (pin 2) and triggers it, generating a high output on pin 3 for about 300µs. Diodes D2 and D3 are included to ensure that IC2 is not retriggered. They charge C2 and C3 while the output of IC2 is high, taking the trigger input of IC2 high.

The transmit enable signal at pin 3 of IC2 is fed back to the PICAXE receiver input on pin 6 via the negative end of C1. The voltage divider formed by the 10kΩ and 100kΩ resistors raise the negative end of C1 to about 0.5V during the transmit burst. This is sufficient to raise pin 6 above the logic high threshold voltage.

After the PICAXE initiates the transmit burst, it uses the **pulsin** command to measure the length of the negative-going pulse at pin 6, with a resolution of 10µs. This pulse is formed from the trailing edge of the transmit enable pulse and the rising edge heralding reception of the first echo. There is no attempt to check that the receiver is receiving a 40kHz signal but as the transducer is highly selective, this method is quite reliable.

When the **pulsin** command completes, the PICAXE again makes pin 3 a high output to charge the two capacitors, ready for the next transmit burst.

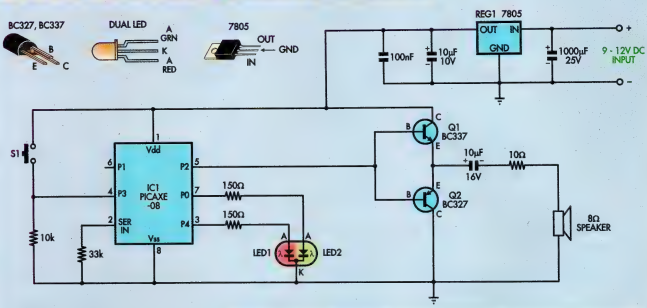
Second burst

The PICAXE now sends a second transmit burst for the sole purpose of measuring its length. The time from the **pulsin** command is then added to the first measurement to correct for the length of the transmit burst. The result is then multiplied by a constant to convert it into millimetres and saved in the *distance* variable.

How you then make use of this measurement depends on the complexity of your robotic project. For example, you could add a few lines to the program to pulse one of the spare PICAXE outputs when an approaching object is detected. This output could then be used to signal the steering controls to change direction.

Andrew Partridge,
Kuranda, Qld.


```
' PICAXE-08 based ultrasonic rangefinder

symbol receiver          = 1            'pin number of the receiver pin
symbol receiver_in       = PIN1
symbol receiver_high     = %00000010
symbol receiver_low      = %00000000

symbol transmitter       = 4            'pin number of the transmitter pin
symbol transmitter_high  = %00010000
symbol transmitter_low   = %00000000
symbol sample_count      = w0
symbol time_to_echo      = w1
symbol burst_time        = w2
symbol distance          = w3

' Charge C2 until receiver pin is high.

charge:
 pause 100                              'allow any echoes to subside
 let dirs = receiver_low + transmitter_high  'receiver pin is input,
                                        'transmitter pin is output

 let pins = receiver_high + transmitter_high  'transmitter pin high

charge_loop:
 output receiver                        'set receiver pin briefly to high output,
 input receiver                         'then to input

 if receiver_in = 0 then charge_loop    'loop until C2 voltage exceeds high
                                        'input threshold of receiver pin

' Discharge C2 to below the high input threshold of the receiver pin.
' Discharge for a pulse, then ensure receiver pin doesn't go high for
' 30 tests. If it goes high before 30 tests, discharge some more.

 let pins = receiver_low + transmitter_high  'receiver pin will go low when
                                        'it is made an output
discharge_pulse:
 output receiver                        'set receiver pin briefly to low output
 input receiver                         'then to input
 let sample_count = 0

discharge_loop:
 if receiver_in = 1 then discharge_pulse
 let sample_count = sample_count + 1
 if sample_count < 30 then discharge_loop

' C2 is now initialised.
' Transmit a burst of ultrasonic energy and measure how long before it
' returns. For now the measurement is displayed in the debug window in
' register w3 in millimetres.

 low transmitter                        'initiate 300us burst of 40kHz sound
 input transmitter                      '5ms from now
 pulsin receiver,0,time_to_echo         'measure time between end of burst
                                        'and first pulse at receiver
 high transmitter

' Measure length of transmit burst and add to time

 if time_to_echo = 0 then no_echo       'only adjust if echo received
 low transmitter                        'initiate transmit burst
 input transmitter

 pulsin receiver,1,burst_time           'measure length of transmit burst
 high transmitter
 let time_to_echo = time_to_echo + burst_time

no_echo:

' Calculate distance in millimetres.
' At 20 degrees C the speed of sound is about 343m/s. The echo travels
' the distance to the obstacle twice, and time is in 10us units, so
' multiply count by 3.4 / 2 to obtain the distance in millimetres.

 let distance = time_to_echo * 17       'multiply count by 1.7 to get
 let distance = distance / 10           'distance in mm.
 debug distance
 goto charge
```



Festive doorbell

At the press of a button, this simple circuit will play one of several Christmas favourites in rhythm with two flashing LEDs. It's similar to the Rudolph project described in the September 2004 edition but with increased output power to drive an 8Ω speaker.

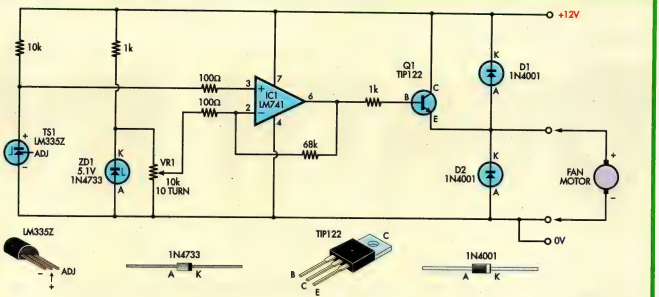
The speaker is driven using a totem pole-connected transistor pair (Q1 & Q2), a 10µF coupling capacitor and a 10Ω current-limiting resistor. The two transistors conduct alternately in response to the square wave signal from the PICAXE tune output (pin 5), producing a signal that swings between +5V and ground.

As shown in the BASIC program listing at right, the program loops until switch S1 is pressed, pulling input 3 (pin 4) high. One of six possible tunes is then selected, based on the output of the random command.

A bi-colour LED was used instead of two individual LEDs (you can use separate LEDs if you wish). This was mounted alongside the pushbutton switch on a wallplate, allowing for easy mounting adjacent to the door.

Mike Talbot,
Griffith NSW. ($40)

```
'Festive doorbell for PICAXE-08M

main:
  if input3 is on then makenumber
  random b1                          'get random number in b1
  goto main

makenumber:
  if b1 > 216 then play1
  if b1 > 180 then play2
  if b1 > 144 then play3
  if b1 > 108 then play4
  if b1 > 72 then play5
  if b1 > 36 then play6

play1:
  play 1,3                           'Jingle Bells
  goto main

play2:
  play 2,3                           'Silent Night
  goto main

play3:
  play 3,3                           'Rudolph
  goto main

play4:                               '12 Days 1
  tune 3,5,($62,$62,$22,$67,$67,$27,$66,$67,$69,$6B,
  $40,$69,$2B,$6C,$40,$02,$44,$40,$6B,$67,$29,$E7,$42,
  $42,$02,$47,$47,$07,$46,$47,$49,$4B,$50,$49,$CB,$12,
  $69,$6B,$00,$4B,$50,$12,$54,$50,$4B,$47,$09,$C7)
  goto main

play5:                               'We Wish You a Merry Christmas
  tune 3,5,($22,$27,$67,$69,$67,$66,$24,$20,$24,$29,
  $69,$6B,$69,$67,$26,$22,$26,$2B,$6B,$40,$6B,$69,$27,
  $24,$62,$62,$24,$29,$26,$E7)
  goto main

play6:                               'Boy Child
  tune 3,5,($67,$67,$27,$6C,$00,$00,$6C,$29,$65,$22,
  $6C,$69,$69,$27,$6B,$29,$25,$24,$6C,$67,$67,$6C,$04,
  $02,$40,$6C,$29,$65,$22,$6C,$69,$27,$00,$6B,$02,$00)
  goto main
```



Junk-box fan speed controller

My new home theatre receiver was getting rather hot in the close confines of its cabinet, with the temperature reaching over 40°C after only about 30 minutes of use. To help lower the temperature, I decided to install a fan in the cabinet. A 75mm hole was cut in the shelf under the receiver, and a 12V fan salvaged from an old computer power supply was mounted underneath. The fan was powered from a 12V DC plugpack.

This did the job, keeping the temperature below 30°C even after prolonged use on a warm day. However, the fan was annoyingly loud when running at full speed.

To reduce the noise level substantially, I built this fan speed controller with temperature feedback. The circuit was culled from variety of ideas found on various sites on the internet, with the final circuit designed from what was in the "junk box".

Air temperature in the cabinet is sensed via an LM335 (TS1). It is glued to a piece of aluminium about 25mm square with instant glue, which is then attached to the top of the receiver with "Blue-Tack". About 300mm of audio coax makes the connection back to the circuit board.

The LM335's output rises 10mV per degree Centigrade. It is calibrated to zero output at -273°C, so at 20°C, the output will be 2.93V. This is applied to the non-inverting input of a 741 op amp (IC1). A 1N4733 5.1V Zener diode provides a voltage reference for the inverting input via trimpot VR1.

The output of the op amp drives a TIP122 Darlington transistor (Q1), which in turn drives the fan motor. The op amp gain was calculated to give about 12V to the fan at 40°C. To keep the transistor cool, it is mounted on the metal base of a small plastic box, which is also used to house the components.

Initial setup should be performed with everything turned off and the ambient temperature at about 20°C. Adjust the 10-turn pot until the fan just stops running.

I used a gasket made from foam strips and "blue-tacked" them between the feet of the receiver to direct all of the airflow through it. The temperature now remains at about 32°C, the fan runs very quietly and continues to run down for about 30 minutes after the receiver is switched off.

Martin Cook,
North Canterbury, NZ. ($35)

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The effect of the introduction of FWA networks on C-band satellite reception in Australia

DEATH BY

by Garry Cratt

Last month, we told you about the introduction of Unwired – a wireless broadband system which (along with several other new players in the game) brings you the internet without the need to plug in to ADSL or cable services.

HOWEVER, as we mentioned at the end of that story, every silver lining has a cloud . . . in this case, it's C-band satellite television reception.

In October 2000, the Australian Communications Authority (ACA) auctioned off part of the 3.4GHz spectrum to three companies, raising over $112 million.

In doing so, they set in stone a progressive rollout of a huge fixed wireless network designed to carry broadband internet services in most populated areas of Australia, one that is already disrupting the reception of over 100,000 C-band satellite viewers across the country.

The ACA had, some time earlier, devised three bands within what they termed the 3.4GHz spectrum. These three bands cover 3.425GHz to 3.575GHz, despite the fact that international satellites such as Apstar 2r, Thaicom 3, Insat and Palapa C2 were delivering signals into Australia on the same frequencies.

In the roll-out prior to the commencement of service in August/September of this year, scores of sites had been equipped with terrestrial transmitters to ensure virtual saturation coverage of Sydney.

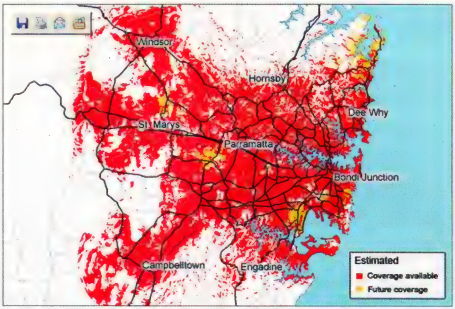
Because these sites rely on microwave or fibre optic connectivity, they have been installed at many GSM (mobile phone) towers and two-way-radio communication sites, where this connectivity already exists. In addition, high-rise buildings have been used to ensure optimum coverage.

Wireless internet users could now experience the benefits of broadband-like Internet speed without connection to a wired service provider.

Houston, we have a problem

But for C-band satellite viewers in Sydney (and soon in most population centres in Australia), a blank TV screen is the result.

Analysing the problem revealed that



From last month's feature, the estimated Unwired coverage area of Sydney. If you're in the red zone, Unwired should be available. If you're close to an Unwired tower OR someone close by connects to Unwired, chances are your C-band satellite reception will be affected, if not obliterated.

OVERLOAD

the most prolific operator is "Unwired Australia" whose wholly owned subsidiary, AKAL, had paid $95 million for licenses in all areas where the spectrum had been made available.

The company claims to own close to 100% of the 100MHz of spectrum that was made available in Sydney and Melbourne, along with the majority of spectrum in Australia's other capital cities.

They utilise the combination of wireless broadband product from US supplier, Navini Networks, backhaul equipment from Airspan Networks, network operations services from Ericsson Australia Ltd, router and IP switching equipment from Cisco Systems and fibre connectivity from Uecomm.

The network uses the 802.16e protocol, a proprietary type of WiMAX technology, yet to be ratified by the IEEE.

The map of Sydney printed last month and reproduced opposite shows the wide coverage of the system. Unwired have licenses allowing them to operate at all sites until December 13, 2015.

So the problem is here to stay.

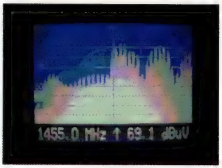
The ACA have a website, **www.aca.gov.au**, which contains a comprehensive list of transmitter sites, power levels, frequencies and radiation patterns, so it is possible to research the probability of interference by location. The site indicates that there are at least 196 separate transmitters, operating from 68 sites licensed to operate in Sydney.

The company is targeting the home and soho market: a potential of 3.5 million people in 1.2 million households and 240,000 small businesses in Sydney.

Unwired's own website states that users are able "to connect within a range of up to 10km from a tower".

Two sources of interference

Not only is interference generated by Unwired towers, the wireless modem supplied to consumers by the company also operates at C-band. This means that wireless broadband users located in very close proximity to a C-band satellite system can also generate interference anywhere within the allocated bands.



Spectral display of signal from satellite Thaicom 3 showing LNB overload as a result of Unwired.

An Unwired modem: itself a source of interference to C-band satellite reception, as are the Unwired towers.

The downlink remedy

The obvious result of operating a terrestrial transmitter on exactly the same frequency as a satellite signal means satellite reception is simply not possible.

Even operating at a power level of a few watts, the terrestrial signal obliterates a satellite signal of a few picowatts. Satellite systems are designed to receive very weak signals and the amplifiers (LNBs) used cannot tolerate having a huge signal forced down the

At left is a single polarity feedhorn; centre shows a waveguide filter which is inserted between the feedhorn and the LNB (low noise block converter) shown at right. Weatherproofing gaskets are used at both ends of the waveguide filter.

input port... it's death by overload!!

In a case of severe interference, the presence of a huge signal on a frequency within the pass band of the LNB means is that the LNB is severely overloaded, sometimes driven into compression.

This results in distortion in the amplifier section of the LNB. The amplifier produces a range of output signals other than the desired one from the satellite, which are mixed with the local oscillator (5.15GHz) – the result being a huge, broad output signal up to 500MHz wide.

In some cases of mild interference, moving the dish to a location shielded from the source of the interference may help. In **all** cases, changing the LNB from one covering 3.4-4.2GHz (extended C-band) to one covering 3.7-4.2GHz (normal C-band) and ensuring that quad shielded RG-6/U cable has been used will help. Of course this means giving up the "extended" part of C-band but that is a small price to pay.

In more severe cases, changing the LNB to the desired frequency range may not cure the problem and it may be necessary to change the LNB to a single polarity type and use a single polarity feed horn.

This means that one polarity will not be available from the satellite. As the interference is vertically polarised, satellite signals of the same polarity suffer more. Satellite channels having a frequency closer to the interfering frequency will be more adversely affected.

In severe cases of interference (the majority of satellite users), it will be necessary to use a special LNB called a phase locked loop (PLL) type, as well as a waveguide filter to eliminate the interfering signal before it gets to the LNB input.

For satellite systems where both polarities must be received, an othomode coupler must be used with two PLL LNBs.

The graph below (from Microwave Filter Company USA) shows the steep attenuation of signals falling outside the filter bandpass limits, in this case 3.7-4.2GHz. Typically, these filters offer 70dB attenuation at the interfering frequency.

Step 2 – the IF remedy

While the best remedy is to remove the interference before it enters the LNB input, some relief from the effects of mild interference can be obtained by "conditioning" the signal after the LNB and before it arrives at the receiver.

A satellite receiver is designed to accept a 500MHz wide band of input signals and, as such, it does not have any great selectivity.

So feeding a high-level signal into the receiver can cause the tuner to be overdriven. In many cases an improved situation can be obtained through the use of an in-line 10dB attenuator.

As well as reducing the satellite signal, the attenuator "deafens" the tuner to some degree, reducing the total amount of input signal and allowing the tuner to operate normally.

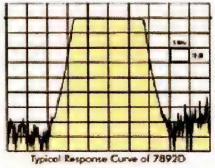
Where the interfering signal is converted by the LNB (along with the satellite signal), it will appear as an IF signal, normally just outside the nominal 950-1450MHz IF band generated by 3.7-4.2GHz LNBs.

An IF filter centred on the interfering frequency can be used to advantage without adversely affecting the satellite signal. Such filters can be inserted in the coaxial line to the receiver and can be configured to pass the DC voltage necessary to power the LNB.

A dual-band combiner also has filtering properties that can be used to

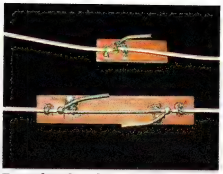
C-band feedhorn fitted with two wave guide filters and LNBs, The combination of waveguide filter and LNB for each polarity ensures reception for all signals.

10dB attenuator - it must be rated to 2GHz and must have DC power passing capability to ensure the LNB is powered.



Actual frequency response graph (taken from "MFC" website) shows sharp cutoff below 3.7GHz and above 4.2GHz.

Dual-band combiner has good IF filtering at 1600MHz.



Examples of single and twin simple open-circuit stub filters.

Ozitronics
www.ozitronics.com
Tel: (03) 9434 3806 Fax: (03) 9011 6220
Email: sales2004@ozitronics.com

40 Second Message Recorder

Record as many messages as will fit in 40 seconds. Messages stored in non-volatile memory. Features message looping option.

K148 - **$30.80** 120 sec version K64 – **$46.75**

Prices Include GST – shipping extra. Full documentation available from website. Over 130 kits available – check website.

advantage. Designed to accept signals from two dishes, these combiners have a high level of filtering to keep the two output blocks of IF frequencies separated. This means that the 950-1450MHz section is very well filtered from the adjacent 1500-2000MHz block of output signals.

So an interfering signal at 3.55GHz (IF 1600MHz) is greatly reduced on the "bypass" (950-1450MHz) port.

A simple IF filter can be constructed to reduce the effects of an interfering signal. By connecting a quarter wavelength open circuit "stub" (tuned to frequency) to the coaxial cable feeding the receiver, 25dB of rejection can be obtained.

Construct two of these filters and place them a half wavelength apart and 70dB rejection can be achieved.

Unfortunately, while the mechanical construction of the filter is simple, measuring the frequency to which it is tuned requires a signal generator and spectrum analyser capable of operating from 1400-2000MHz.

One drawback of the stub filter is the bandwidth that can be achieved. This type of filter can only achieve 10dB of rejection for every 10MHz of bandwidth, so a filter producing 70dB of rejection will be something like 70MHz wide. If the interfering frequency is less than 70MHz away from the desired satellite signal, the filter will attenuate the satellite signal as well.

The other problem is that the stub length is critical. A change in length of 1mm results in a shift in the centre frequency of 100MHz!

It is possible to construct elaborate cavity filters offering narrow bandwidth and sharp frequency response, but the effort and cost put into this would be better spent on a filter before the LNB.

The picture below shows such a multi-cavity filter and the frequency response achieved.

Step 3 – the receiver remedy

Finally we come to the receiver itself. There is a huge difference in tuner performance between receivers.

Generally it, is true to say that the cheaper satellite receivers will probably give poor results compared to the more expensive models.

Cabling and connectors are another area where attention to detail can help eliminate interference problems.

In cases of high-level interference, where RF energy not only drives the LNB into compression but also enters the coaxial cable, it may be necessary to run the vertical sections of coaxial cable in metal tubing for maximum protection. This is particularly noticeable when a waveguide filter has already been used.

Even wrapping connectors in aluminium at the point of ingress may assist.

Having eliminated the primary route of the interfering signal, other more minor problems that still contribute to the overall problem are more readily noticed.

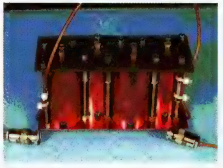
Crimp connectors can give problems because they fail to provide continuity of shielding and a low impedance bond to the coaxial shield.

Instead of a continuous bond between the coaxial shield and the body of the connector, crimp connectors provide only six points of earth bonding.

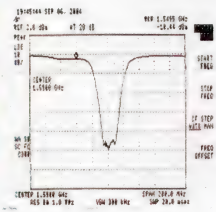
The use of compression connectors resolves this issue.

Part Two of this series, to be published next month, examines available remedies to the problem. **SC**

Use of F-type compression plugs ensures consistent, low-impedance earth connection –vital for minimising interference.



Highly effective laboratory-built IF notch filter prototype has narrow bandwidth and deep-notch capability, as shown by its response graph at right.



If you'll excuse our Latin . . .

Sydney readers can meet Stan Swan at the PICAXE fair, December 10th – see page 43!

Picaxus Interruptus

The new PICAXE-08M has been winning lots of new friends around the world. Sorry to interrupt but here's yet another example of why that is!

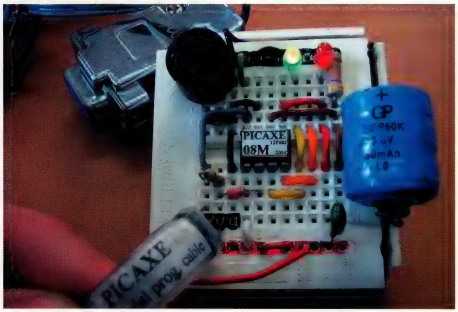
by Stan Swan

Unlike 2003's popular PICAXE-08, 2004's new 08M baby offers valuable interrupts to program flow. Such enhanced control has only been previously been available on the more costly Picaxes (typically the 18X), so this new command is quite a bonus, with significant potential for professional applications at a budget price.

Although understanding Picaxe interrupts can be daunting, they turn out to be quite straightforward to use. However they're not usually an issue for PICAXE beginners and hence can initially be neglected. If you're still at the HIGH 1: PAUSE 100: LOW 1 stage then perhaps return to this article later, since their benefits often arise when trying to polish a programs action.

OK - but what ARE these so-called "interrupts"?

Interrupts to computer programs are similar to interruptions that plague our daily lives. If mid-way thru' a thriller video your phone rings, then you'll probably pause everything and take the call. (If it's a Kiwi-made "Lord of the Rings" video you'll no doubt welcome the chance to subdue your envy!) You're effectively primed to break out of the viewing routine when such random phone calls arrive. Not all activities accommodate such branching of course, with perhaps gunfire the most dramatic – bullets hurtle to the target irrespective of the hunters 2nd thoughts after pulling the trigger.



Lashed up in the usual protoboard style, the PICAXE-08M ready to demonstrate its interrupt capabilities. It's powered by a 3.6V nicad battery (blue cylinder).

Most PICAXE programs are however essentially sequential in nature – first do this, now this, then this – with any breaks out of the sequenced flow first awaiting completion of an ongoing operation. Hence if a lengthy WAIT is underway, perhaps WAIT 60 (1 minute), then *no further actions will occur until* this period is timed out. Grr- naturally this may be frustrating! It's comparable perhaps to customers twiddling their thumbs while serving staff finish their coffee break…

Wouldn't it be more convenient if your needs could be considered in a more streamlined manner?

Tarah! – enter the interrupt command, or more correctly – a polled ("checked") interrupt.

Not all Picaxe commands can be interrupted, since some require the full attention of the micro controller once they have started to execute. For the Picaxe-08M these high priority non interruptible commands are –

- INFRAIN2 - receiving IR data
- INFRAOUT - sending IR data
- NAP - brisk sleep (<2.3secs)
- SLEEP - long "hibernation" sleep
- SERIN - awaiting serial data
- SOUND - production of simple sounds

Annoyingly the power saving SLEEP is on this list, meaning very lengthy delays, with immense power saving benefits, still have to run their course. It's maybe akin to hibernating animals only being awoken by the arrival of spring.

WAIT (the shorter time delay) *is* interruptible, so delays up to a minute

are thus viable. The PLAY and TUNE commands can be interrupted partway through, after each note has been completed, even though a SOUND command cannot. When a PLAY or TUNE command is interrupted, any notes that haven't been played will be discarded and execution after the RETURN from the 'Interrupt:' routine will continue at the statement following the PLAY or TUNE command that was interrupted. Argh – shades of musical chairs!

Probably the most valuable contribution involves a PAUSE or WAIT command interruption that immediately terminates normal (short) delays. Hence a WAIT 30, for a ½ minute delay, will be chopped short as the interrupt is sensed. It's almost a WAIT – "UNLESS" situation – wait for the next bus unless a mate offers you an earlier lift?

Configuring your program – SETINT

The SETINT has two arguments, a 'compare with value' (input) and an 'input mask' (mask) in that order. The syntax, although in cryptic binary (%), is in fact akin to the efficient presetting of normal Picaxe I/O channels with 'LET PINS' . Thus -

let pins = %00000000 switches all outputs off while %00000010 turns just pin 1 high

These binary digits read R-L, with the left most being 7. With interrupts, the 'input mask' defines which pins are to be checked to see if an interrupt should be generated.

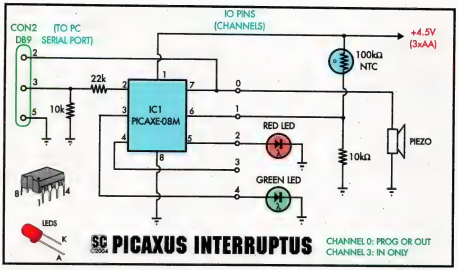
%00000001 will check input pin 0
%00000010 will check input pin 1
%00000100 will check input pin 2
%00001000 will check input pin 3

These can be usefully combined to check a number of input pins together ...

%00000011 will check input pins 1 and 0

%10000100 will check input pins 7 and 2 (useful for the larger Picaxe –18X)

Having decided which pins you want to use for the interrupt, the value determines the second parameter of the SETINT command. Once a SETINT is active, the PICAXE monitors the pins you have specified in 'input mask' where a '1' is present, ignoring other pins. Every time the PICAXE checks these input pins it creates an 8-bit value which reflects the value of the pins it did read with others being forced to zero.



The circuitry – programming, I/O, etc – remains the same for the 08M as the 08.

Example: an input mask of %00001100 will check pins 3 and 2 and create a value of %0000ab00 where bit 'a' will be 1 if pin 3 is high and 0 if low, and bit 'b' will be 1 if pin 2 is high and 0 if low.

The 'compare with value', the first argument of the SETINT command, is what this created value is compared with, and if the two match, then the interrupt will occur, if they don't match then the interrupt won't occur.

If the 'input mask' is %00001100 (meaning pins 3 and 2), then the valid

PROGRAM LISTING

Available for downloading from www.picaxe.orcon.net.nz/int08m.bas

```
'Demo "barebones" Picaxe-08M polled interrupt handling. Ver 0.9  28th Oct 2004
'Overall effect is a Chernobyl alarm- a monitoring status beep & LED flash every
'minute if cool, but alarm instantly sounds if NTC sensor thermistor gets too warm!
'NB-works reliably as is, but possibly refine with READADC & PIN status check ?
'
'Triggered by raised temps(~60C) when NTC R falls to ~30k,since Ch.1 input then -
'goes high. Returns to low (0) when it cools <60C. NTC & R voltage divider involves
'+supply--(10k)--Pin 1--(100k NTC)--ground. Alter 10k &/or NTC value to suit your
'own alert temp (Jaycar 100k @ 25C used here).Red LED Ch.2 & Green LED Ch.4, with
'piezo on Ch.0.Program hosted for download at =>www.picaxe.orcon.net.nz/int08m.bas
'Protoboard layout =>www.picaxe.orcon.net.nz/pcxs08m.jpg (as used 08/M datalogger)
'via Stan. SWAN => s.t.swan@massey.ac.nz  for Dec. 04 "Silicon Chip" article.
'-------------------------------------------------------------------------------
 SETINT %00000010,%00000010   'Go to Interrupt routine when Pin 1 goes high

statusloop:                   'Normal cool monitoring routine
sound 0,(100,10)              'Audible beep for operator if room very bright
high 4                        '\
pause 500                     ' Brief green LED flash in case noisy room
low 4                         '/
wait 60                       'Temperature status interval (wait 60 ~1min)
goto statusloop               'Continue "all OK" safety status looping


interrupt:                    'Beep/LED code when thermistor hot
sound 0,(100,10)              'Urgent beeps
high 2                        '\
pause 100                     ' Rapid attention getting red LED flashing
low 2                         '/
SETINT %00000010,%00000010    're-enable interrupt
RETURN                        'allow the interrupts
```

'compare with value' can be one of the following 4 binary options...

%00000000 - Pin 3 = 0 and pin 2 = 0
%00000100 - Pin 3 = 0 and pin 2 = 1
%00001000 - Pin 3 = 1 and pin 2 = 0
%00001100 - Pin 3 = 1 and pin 2 = 1

So if you want to generate an interrupt whenever Pin 3 is high and Pin 2 is low, the 'input mask' is %00001100 and the 'compare with value' is %00001000, giving a SETINT command of –

SETINT %00001100,%00001000

Thus the interrupt will then occur if, and only if, pin 3 is high (1) and pin 2 is low(0). Other combinations – maybe pin 3 low with pin 2 high - will not trigger the interrupt.

Processing the interrupt

Interrupts are not enabled until the first SETINT is encountered. After that, any input interrupt condition which is met causes a subroutine jump to a routine which must be labelled 'Interrupt:'. The RETURN of that routine cause execution to continue from the point where the interrupt occurred.

With interrupts enabled the PICAXE monitors the input pins specified by a SETINT to determine if an interrupt has occurred, and if so a subroutine jump to the 'Interrupt:' routine is made. The input pins are checked ("polled") just before each PICAXE statement is executed, but not while that statement is executing. This means that the interrupt must exist for long enough for the PICAXE to sense, else it'll be missed if it appears only while the PICAXE is busy doing something else.

When the 'Interrupt:' routine is entered, the SETINT is disabled and must be re-enabled for further interrupts to be responded to. Interrupts are re-enabled by issuing another SETINT command which is activated when the RETURN of the interrupt routine is executed

It is important that the condition which initially caused the interrupt has 'disappeared' or when interrupts are re-enabled and the RETURN is executed, another interrupt will be immediately seen. . It's rather like your mates queuing up to give you a lift – you only need a single ride at that time but could do with another ride tomorrow if the bus is again late. If the interrupt was caused by a button push, then the interrupt routine should check if that button is still held, and only re-enable the interrupt and continue when it has been released.

The following code demonstrates how to handle an interrupt caused by a button switch which sets Input Pin 3 to 1 when pushed (perhaps via a voltage divider) and to 0 (maybe via a pull down resistor) when it is released ...

```
SETINT %00001000,%00001000
'Go to Interrupt routine on Pin 3 High
loop:
    Main program code
GOTO loop
interrupt:
    Code to do something when button
pushed
buttonhold:
IF pin3 = 1 THEN buttonhold
'stay here if button still held on
SETINT %00001000,%00001000
're-enable interrupt
RETURN
'allow the interrupts
```

There – that wasn't too bad! Further sophisticated extensions are possible with clever use of diodes. With lateral thinking a second Picaxe, devoted perhaps to a memory hungry task, could even be switched on by an interrupt driven 08M.

PICAXES can "source" (supply) some 20mA a pin – easily enough to supply the ~5mA needs of a second bare 08. Transistors could amplify this source current of course.

Chernobyl alert

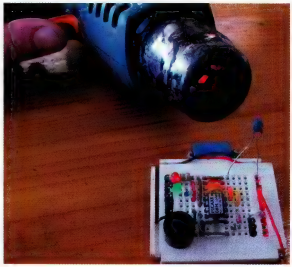
Here's short program that illustrates 08M interrupts at work in a realistic application.

This uses almost exactly the same hardware layout as our October 08M NTC data logger, and pulses an "all OK" green status LED every minute, unless the temperature suddenly becomes too high (Chernobyl?). Urgent LED flashes (red = hot) and distinctive tones should be *immediately* given in such circumstances. Naturally holding on (if still hot) and resetting (once temperatures fall to safe levels again) needs considering too.

If a classic PICAXE sequential routine had been used, it would first need to work through a WAIT (here 1 minute) before encountering the commands to detect the temperature rise and sound alarms. Yikes – your reactor could have melted down by then…

In our case, a quick blast from a hot air gun readily triggers the alarm at about 60°C.

Rather surprisingly, normal PICAXE commands that monitor pin status (readadc, pin etc) were found redundant in this example, as the NTC/10kΩ voltage divider, under a 3 AA (4.5V) supply, was alone enough to determine 0/1 logic states for the interrupt settings at input pin 1. Your mileage may vary !



A quick burst from a hot air gun readily heats the sensor thermistor enough to alert the snoozing PICAXE. This alarm temperature can be easily altered (here ~60°C) by changing the thermistor and voltage dividing 10kΩ resistor values.
Note – although neglected on this simple 3.6V breadboard, the 2 LEDs strictly should use dropping resistors, especially on higher supply voltages.

References:

1: Picaxe Programming Editor help (F1 & .pdf) provides interrupt help
2: Generous interrupt insights were provided by "Hippy" from the online Picaxe support forum – **www.rev-ed.co.uk/picaxe/forum**
3: **www.picaxe.orcon.net.nz/pcxs08m.jpg** shows the 08M NTC/LED layout, with just a single resistor changed (47kΩ to 10kΩ) for this example.
4: **www.picaxe.orcon.net.nz/int08m.bas** hosts the Chernobyl Alert program.

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12-04

By RODNEY CHAMPNESS, VK3UG

The AWA B79 transistor mantel

Most Australian-made transistor radios from the 1960s and 1970s ran on batteries. Not so the AWA B79 – it ran on mains power so that it could operate for long periods as a mantel receiver. It's an interesting unit that was let down by manufacturing compromises.

During the 1960s and 70s, valve mantel radio receivers gradually gave way to transistorised portables. Unfortunately, many of these new receivers were quite hard on batteries and so were relatively expensive to operate in the house as a kitchen mantel receiver.

As a result, manufacturers such as AWA decided to adapt some of their transistor portables and produce models that were mains-operated. So which model AWA portable was the B79 AC mantel set's twin? I'm not sure.

The AWA B79

The B79 is a small 7-transistor unit with a compact power supply and a relatively heavy 2.6-metre 3-core power lead. I've owned this unit for some time but as with many other pieces of equipment, I had to grab it when I could and put it aside until I could find time to restore it.

The set isn't particularly eye-catching in appearance, its importance being its place as part of our radio heritage. In fact, a relatively small portable (for that is what it is) sporting a 3-core mains power lead seems rather incongruous.

The cabinet in this example is made from red plastic and a quick examination soon reveals where the battery would have fitted in the portable version. There would have been enough space for a 2362 9V battery but its life would have been quite limited, since this battery is quite small. As a result, the portable version would have been expensive to run if used as a mantel receiver.

The quality of the cabinet and particularly the "chromed" escutcheon is of only fair quality. Over this set's life, the "chrome" has worn away in a number of places, revealing the yellowish colour of the plastic under the "chrome" finish.

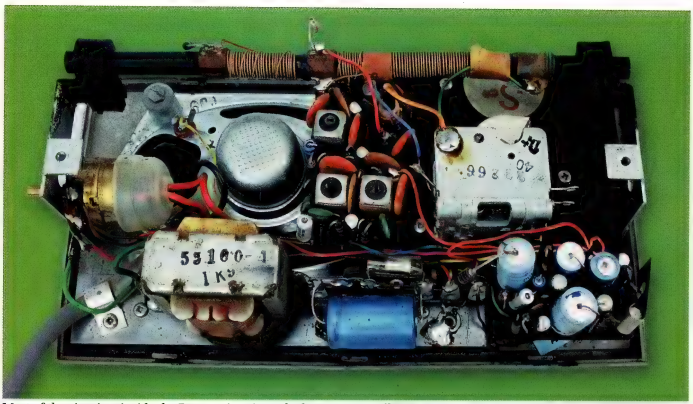
Although the set can be cleaned up and made to look reasonable, "re-chroming" the front just isn't on. As a result, the set still looks a bit "worse for the wear", even after restoration.

This view shows the B79 receiver before restoration. The heavy 3-core power lead looks out of place on such a small set.

Broken loop-stick

The first problem with this set was that the loop-stick antenna had broken in half. Obviously, the set had been dropped at some stage, causing this rather brittle component to break. There was no other damage to any other parts though.

A set won't work at all well with a broken loop-stick and this meant that it had to be repaired, as replacements for many of these units are simply no



Most of the circuitry inside the B79 receiver is packed onto two small PC boards. The ferrite loop-stick had broken in half and was repaired by gluing it back together using Araldite®.

longer available. If it's a clean break, the job it relatively easy – just glue the two sections together using Araldite® and the rod will be nearly as good as new. The only thing required may be a slight adjustment of the antenna coil on the rod.

The next problem was that the brackets supporting the loop-stick antenna had nearly rusted through. As a result, I gave them a spray with Inox® contact cleaner/lubricant to prevent any further deterioration. Unfortunately, that wasn't enough and the brackets quickly fell to pieces as soon I started to work on the receiver.

This problem was easily fixed. I have quite a good collection of plastic cable clamps, so I rummaged through my supply until I found a couple that were the right size. These were then used to hold the loop-stick securely in place.

Don't make the mistake of using metal clamps for this job. If you do, they will act as short circuits as far as the tuned circuit is concerned and the efficiency of the antenna will be severely compromised.

Internal layout

Most sections of the receiver are built on two small boards – one for the audio and the other for the radio frequency (RF) and intermediate frequency (IF) sections. Apart from AWA, quite a few other manufacturers also tried this modular approach, with Philips probably making more sets along these lines than anyone else.

The idea, apparently, was that a faulty module could be replaced, without having to track down (and fix) individual components. However, the cost of the replacement modules was usually too high to do this and service technicians were used to replacing individual components anyway. That said, replacing individual components would not have been easy, as they were packed tightly together (see photo).

The power supply is installed where the battery would have been fitted. It is a simple little half-wave unit with a nominal output of 9V, depending on the setting of the volume control.

Circuit checks

Once the loop-stick antenna had been fixed, the PC boards were carefully inspected for possible faults but this revealed no further problems. Plugging the set in and switching on soon told a different story, however – there was no audible output.

This problem was quickly solved. Moving the RF/IF board caused the sound to cut in and out intermittently, after which the fault was quickly traced to a broken track in one corner of the board.

This broken track was basically caused by a manufacturing fault. As a cheap way of mounting the RF/IF board, an untrimmed resistor pigtail in one corner was fed through a hole in the underlying phenolic mounting board (not the PC board). This lead was then bent so that it ran along the underside of this board, after which it was secured with contact adhesive.

Fairly obviously, the other corner of the board was meant to be secured in the same way but the pigtail on

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Photo Gallery: Keogh TRF Receiver

Manufactured in 1928, this Keogh 3-valve TRF receiver was produced by a small Australian manufacturer. It was fitted with three A609 (or equivalent) valves and was battery powered – 6V filament, -4.5V bias and 90V HT. Unusually, the cabinet was made of wood but was painted to appear like the metal cabinets that were more common during that era. Because of its low power output, the set would have mostly been used with headphones. Photo: Historical Radio Society of Australia, Inc

that resistor had been bent out of the way. As a result, the job had never been completed and this meant that the board could "flop around", eventually breaking the track around the resistor lead.

The track was easily repaired by soldering a 15mm-length of tinned copper wire along it – see photo. This is a fairly common technique for repairing tracks on PC boards.

Alignment

With the set now running reasonably well, it was time to check the tuning range. This immediately revealed a problem when the tuning gang was fully meshed, the set being tuned to 500kHz instead 525kHz as it should have been. This was fixed by screwing the oscillator coil slug out until 525kHz was tuned in.

I then went to the other end of the tuning range and found that the oscillator was tuning to 1800kHz, so I screwed the oscillator frequency trimmer in to bring it down to 1750kHz. This allows the set to tune all the new services in the range from 1602-1701kHz. (Note: the 1750kHz range allowed the set to tune to University of Adelaide station 5UV, which is marked on the dial. It has long gone from that frequency allocation.)

The next step was to check how successful the loopstick antenna repair had been. The small coil at the end of the loopstick (near the green wire) was glued in position and couldn't be shifted, so I tried adding extra turns of wire to get the inductance right. I went from three turns to eight turns and ended up back at three turns as the optimum number, with the turns spread slightly.

This was done by tuning to a weak station at the low-frequency end and moving the turns along the loop-stick with a small screwdriver to obtain the best performance. Once that had been achieved, they were glued into position using epoxy resin.

The high-frequency end of the dial was optimised by adjusting the antenna trimmer. The performance was now quite good. I also checked the IF alignment but it appeared to be spot on so it was left alone.

Actually, the performance of this little receiver is quite good, even inside a metal garage, and I was able to tune a number of Melbourne stations from my location in northern Victoria. The set has no provision for an external antenna and for suburban use the set performs well without one.

That said, this appears to be one of the few simpler transistor sets (ones without an RF stage) that will work with an external antenna/earth system. As an experiment, I wound a few turns of thin hook-up wire onto the ferrite rod and connected one end to my outdoors antenna and the other to the earth. The performance improved noticeably, with little in the way of "hiss" generated by the receiver on weaker stations.

Connecting an antenna and earth to a transistor receiver in this manner often causes it to pick up all sorts of shortwave stations, as well as the sought-after stations on the broadcast band. This is due to a problem with the local oscillator. What happens is that the oscillator generates numerous harmonics in addition to the intended signal and, due to poor front-end selectivity, short-wave signals are easily fed to the converter.

Wonky dial

Poor quality control is again evident with the dial scale assembly. The paper dial scale is not only glued in the wrong position but is also crinkled. As a result, the handspan plastic tuning wheel has worn away a section of the dial scale where it has been rubbing.

Unfortunately, there's little I can do about this except get another set with a good dial scale and replace the front of the set. In the meantime, I've cleaned the handspan tuning wheel and the dial scale as best I can.

Low-level hum problem

By now, I was quite pleased with the set's performance except that its hum

level was greater than I would have liked at full volume and off station. Suspecting a fault, I began by checking the electrolytic capacitors but they all appeared to be in good condition.

In fact, I doubt that I can do much about the hum without a lot of experimentation, as the low-level audio leads run right up against the power transformer windings. I tried lengthening the audio leads and dressing them away from the transformer but there was no noticeable improvement.

The only thing that did make an improvement was to increase the value of the first electrolytic capacitor from 1000µF to 2200µF, so I have left it at that. Even so, a hifi enthusiast would not be impressed with the hum level and neither am I. A bridge rectifier in the power supply in lieu of the single diode that was used would certainly have made the hum less obvious but it looks as though AWA had tried to keep the manufacturing cost as low as possible.

Having said all that, the hum is hardly noticeable when the set is tuned to any reasonable station at "normal" volume.

Transistor functions

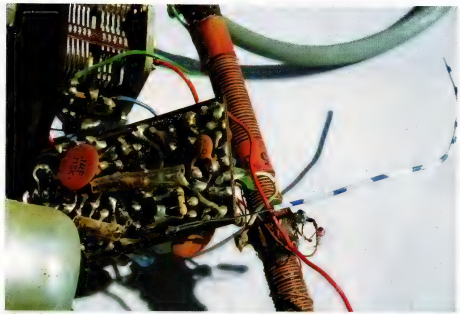
Unfortunately, I haven't been able to find a circuit for this set in my collection. However, it would almost certainly follow the style used in many other AWA sets of the same era.

The receiver comes with a small stick-on label (which had fallen off) inside the cabinet, which shows the physical layout plus the semiconductor complement. The transistors used consist of an AS300 as the autodyne converter, an AS300 as the first intermediate frequency (IF) amplifier and an AS302 as the second IF. An OA91 diode is used as the detector, while the audio amplifier stage consists of a 2N408, an AS311, an AS313 and an AS128.

Finally, in the RF section there are additional OA91 and OA95 diodes which assist with the AGC operation and prevent input overload.

Summary

The B79 is quite a reasonable performer – better, in fact, than many of the same vintage. However, AWA could have improved the power supply by using a full-wave bridge rectifier instead of a half-wave design. This would have given a worthwhile reduction in hum and the extra cost would have been minimal.



This close-up view of the copper side of the RF board shows how tinned copper wire being was used to repair a break in one of the tracks (blue/white wire).

The plastic cabinet back has proved to be of good quality, with virtually no discoloration. By contrast, the plating over the plastic front of the receiver is poor and has either worn away or has become pitted. Another problem area is the dial-scale, which is just a piece of heavy paper with the stations and brand name printed on it. As stated, it wasn't fitted correctly on this particular unit and, as a result, has been damaged by the handspan tuning wheel.

Although many of these carelessly assembled parts and low-quality items have been repaired to some extent, the set still doesn't look as good as it should. Perhaps it was a symptom of the deterioration in quality control as radio receiver manufacturing ceased in this country.

So what was potentially quite a good little set has, in my opinion, been spoilt by lack of quality control. **SC**

The B79 still looks a bit "worse for the wear", even after restoration. Note the poor condition of the metallised plating on the front of the set and the badly fitted dial scale.

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Transformer for Studio 200 amplifier

Can you tell me if it is possible to use a 40-0-40V 300VA transformer with the Studio 200 Amplifier published in February 1988 and is it possible to bridge it? The original article specifies 35-0-35V 300VA. My brother has one and I've got a 40V tranny which I was thinking of using. (E. Z., via email).

● Yes, you can use your 40-0-40V transformer. And yes you could use the amplifier in bridge mode to drive 8-ohm speakers (NOT 4-ohm!).

Converting TV sets to oscilloscopes

I have had an oscilloscope on my bench for many years – a BWD 509B – the CRT for which has sadly died on me. I have been trying to locate a source of supply for a new CRT without any luck. A 130BUB series type is required. If you know of a source of supply I'd be grateful for the information.

Alternatively, I remember that, many years ago, Radio, Television & Hobbies, brought out a circuit which converted a small TV to an oscilloscope. I don't know whether it was ever produced in kit form. Do you have any information on this? (L. N., Queenbeyan, NSW).

● EA magazine published a CRO adaptor for TV in May 1980. This was useful for audio frequencies only.

These days, a better approach is to build a sound card interface for your PC and then use oscilloscope software from the internet, as detailed in our August 2002 issue.

Car subwoofer amplifier not economic

Any chance of a car subwoofer amplifier? Yes we all hate them but my senior students keep asking for it. (D. K., via email).

● A car subwoofer is not an economic project when you take into account the need for a high power inverter. You are better off buying a built system from Jaycar. On the other hand, if you use an efficient subwoofer, you can use the 70W Mighty Midget class-H amplifier featured in the March 2002 issue. This was also used in the PortaPal PA Amplifier featured in February & March 2003.

USB power for Micromitter

How would I go about powering the Micromitter FM transmitter (SILICON CHIP, December 2002) via USB? What is the range on this unit? (S. D., via email).

● You can power the Micromitter via a USB port by connecting up power as per the battery power overlay. The 5V can be obtained from pin 1 (5V) and pin 4 (0V) on the USB port. Transmission range should be around 15m.

CFL driver will not work with 110V CFLs

The circuit in the September 2004 issue entitled "Oh no! Not Another CFL Inverter" is very interesting but I'm not sure what it's supposed to power. 370V DC? Is this for a tube type CFL and not the kind that normally fits into a light socket (with the built in ballast)? In America, this obviously won't power light socket CFLs at 12VDC input but possibly would power CFLs from 6V?

Is this for powering just the CFL plug-in tubes? (K. C., Cypress, USA).

Smoke Gets In Your Eyes (Especially If The Zener Diode Is Wrong)

I am having a problem with the Keypad Alarm circuit, from the April 2003 issue. I have triple checked all the components and solder joints and all appear to be fine. The problem is that the first three components on the power input circuit get extremely hot and smoke is visible.

The 10Ω resistor (first on the circuit) has burned out a number of times and each time I have replaced the part with a higher rated part, I am currently running a 10Ω 5W ceramic resistor. So far this appears to be OK, however this part and the first two diodes still get very hot and smoke can still be seen!

Other than this the alarm functions correctly and is fully functional. The power source I am using is a 12V SLA 7.0Ah battery as recommended in the documentation supplied.

Would you please be able to advise me on any ways to correct this problem? (A. P., via email).

● Heat and smoke are symptoms of a serious fault so you can't just keep on installing a bigger resistor. That is akin to "using a bigger fuse".

Our guess is that the zener diode is the wrong voltage rating. If it was in the wrong way around, the circuit would not work at all.

To check this, first measure the output voltage from the 78L05 regulator – it should be 5V. If it is 5V and the regulator is not getting hot, either the zener diode (ZD1) is not 16V or the 100µF 16V capacitor is in the wrong way around. On the other hand, if the 78L05 is getting hot, or has the wrong output voltage, then you have a short or a faulty component elsewhere on the PC board.

Try pulling out the zener diode. If that solves the problem, it was the wrong voltage rating.

● In countries like Australia which have domestic mains power supplies of 220-240VAC, CFLs have an internal bridge rectifier to produce about 320V DC, the same as delivered by the CFL driver circuit. Because 240VAC CFLs have this internal bridge rectifier, they can run on DC/DC converter circuits like the CFL Driver.

In countries like the USA which have mains supplies of 110-120VAC, CFLs have an internal voltage doubler rectifier (typically two 22µF 200V electrolytic capacitors and two 1N4007 diodes) to again develop around 320V DC. Because of their different rectifier arrangement, these 110V CFLs cannot run from a DC/DC converter. Nor can they run from a high frequency DC/AC inverter because their internal rectifier diodes and capacitors are not designed to cope with high switching frequencies.

XP reports USB overload

I recently built the USB Power Injector described in the October 2004 issue of SILICON CHIP. It works as described but despite using it ahead of a 4-port unpowered hub I still get messages from Windows XP stating that the device exceeds the power capability of the USB port. Do you have any suggestions as to how I might overcome this problem?

● The unpowered hub will be unaware of the fact that additional power is available to it and will therefore continue to report an overload condition to Windows. This is completely normal.

Mods to PowerUp to use with PC

I've just finished building the Power-Up project (kit sourced from Jaycar) from the July 2003 issue. I thought you might be interested in a slight mod I had to make.

I am using a PC of moderate specification (400MHz Pentium II with two hard drives) and found that the kit was too sensitive with this on the master outlet. It would activate the slave appliance outlet with trimpot VR1 almost fully anti-clockwise but it would not shut this outlet down when the PC was turned off.

The reason for this was that the standby current was too large. The output of IC1a was just under 10V p-p when the PC was in standby. By decreasing the gain of the first amplifier (IC1a) from 471 to 69, I was able to get the unit working as planned. This required replacement of the 470kΩ resistor in the feedback loop around IC1a with a 68kΩ resistor. (S. H., via email).

High & low side driver explained

I am experiencing difficulties with technical jargon and in your website it says that I could ask. What is the meaning of the terms " high side driver" and "low side driver" for a solenoid driver? (P. C., Sao Paulo, Brazil).

● A high side driver is like a switch in the positive line to the solenoid while a low side driver is in the negative (ground) side of the solenoid.

Polarity explained

I have read the article entitled "Shut That Mutt" in the April 2004 edition and I have big hopes that my 5:00am early calls from the neighbour's dog may be nearing an end.

I am a raw novice and I have a question. On page 37 of the April 2004 edition, left-most column, second last paragraph, you say "watch the polarity". In the next column paragraph 2, referring to the LED, quote "Again watch the polarity".

Polarity is my issue. I know there is positive and negative but would you have a magazine issue that will show me how to recognize how to get the polarity correct on electrolytic capacitors, LEDs, and it seems, the tweeters in this case? (B. C., via email).

● If you have a look at the PC overlay diagram (Fig.3), you will see that LEDs and some capacitors have plus (+) signs near or on them. This shows how these components must be installed. That is what we mean by polarity.

As far as components like capacitors diodes and LEDs are concerned, the polarity must be correct otherwise the components themselves may be damaged or the circuit won't work correctly.

Valve Preamplifier Power Supply Problem

I am querying the construction details of the power supply section of the Valve Preamplifier project (SILICON CHIP, November 2003). I have followed the instructions *exactly* or would have the first time if the kit had a long enough section of the 0.2mm wire! My second attempt at winding the secondary WAS right.

First, the kit came with an IRF-820 instead of the schematic's STP-6NB50 Mosfet. I did a quick web comparison and this seems to be a valid substitution. All the rest of the power supply is straightforward and went together easily.

On initial switch-on (being fed from my bench supply current limited to about 400mA), the output only rose to about 10V (DC) and the Mosfet started warming faster than I thought it should. I progressively upped the current limit only to see that the Mosfet just got warmer and the output stayed at about 10V. So I stopped that test before the melting started!

I hooked up my scope and checked the switching output waveforms from the TL494 IC and all looks good at a frequency of about 29kHz. To reduce the dissipation on the Fet, I substituted a resistor for the primary coil and the output switching is all going rail to rail on the Fet Drain.

Refitting the transformer and checking with the scope for the flyback pulse – it looks correct on the primary but I get nothing at all on the Secondary (Finish); no AC whatsoever. I can't help thinking it might be phasing on the transformer (but I forgot that theory ages ago!).

If there was a project "revision" in a later magazine, please refer me to it. (N. P. via email).

● Since the Mosfet appears to switching the primary correctly, it sounds as though you might have a shorted turn in the secondary. You might be wise to rewind the transformer, following the instructions very carefully!

Light Bulbs In Microwave Ovens

My teacher told me that if you put the metal part of a normal (mains-powered (household) light bulb into a bowl or glass of water (the glass part is out of the water) and put it in the microwave, the bulb will light up.

Is this true? If it is, how does it work? (D. H., via email).

● This could be the basis of an urban myth and could be a good way of blowing your microwave oven if you don't know what you are doing.

What happens is this. You must have a glass of water in the microwave to provide the magnetron with a safe load. Then, when you turn on the microwave oven, the RF energy in the oven compartment excites the filaments and what typically happens is that the sections of the filament are progressively blown out as they heat up and become white-hot.

So yes the light bulb does light up as each section of the filament glows and lights but then you are left with a defective bulb. It is probably a good idea to have the metal section of the bulb immersed in the water because otherwise it may constitute a "shorted turn" in the microwave energy field.

As far as the tweeters are concerned, no damage will result if they are not connected correctly but their phasing will be incorrect so that their diaphragms will not both move in the same direction. Hence their outputs will tend to cancel rather than reinforce each other.

Remote control extender for multiple units

Can the Remote Control Extender Kit Mk.II (SILICON CHIP, July 1996) be extended to link up to four or five units, for example DVD, Video, Satellite Foxtel, Satellite Digital set-top and hifi amplifier, by simply adding the additional three of four infrared LEDs for each unit and having only one single IR unit in the line of sight of the remotes for each device. (H. C., via email).

● You can use several infrared LEDs instead of a single one. You can connect three in series and change the 220Ω resistor to 100Ω. For even more LEDs, you can connect another series string in parallel with the first. Connect the second string between the collector of Q1 and the 9V supply.

Jumbo LED clock has link options

I have built the "Compact Jumbo LED Clock" from the March 2001 issue of SILICON CHIP but I can't get it to work at all. Instead of the colon flashing, a "1" flashes instead. Are there any faults with the design? (D. D., Blenheim, NZ).

● The Jumbo LED Clock had link options to suit both versions of the large displays specified. These are marked "S" and "V" on the display board. You must install either the "S" or "V" links, not both. It would appear that you have selected the wrong link option for the displays you are using. Try connecting with the alternative linking.

TV signal strength/ quality meter wanted

Our channel 10 signal seems to have another faint signal with it. Can you recommend a meter and information so I can test for this and any advice on filtering it out? I'm an electrician so I'm OK using meters but I just need a bit of educating about TV signals. (S. K., Toronto, NSW).

● There is no simple meter for measuring TV signal strength – you would be looking at an instrument costing several thousand dollars. Even then, it would not show "signal purity" or the strength of an interfering signal on the same channel.

In summer time (on hot summer evenings) there is often co-channel interference between TV channels on the same frequency – it could be from a station on the channel 10 allocation hundreds or even thousands of kilometres away.

The signal is bounced off the troposphere and causes a characteristic noisy "venetian blind" effect on the picture. This can happen with any VHF channel but is not common on UHF channels. Apart from the possibility of using a more directional antenna to discriminate to the wanted signal, there is nothing you can do about it.

WARNING!

SILICON CHIP magazine regularly describes projects which employ a mains power supply or produce high voltage. All such projects should be considered dangerous or even lethal if not used safely. Readers are warned that high voltage wiring should be carried out according to the instructions in the articles. When working on these projects use extreme care to ensure that you do not accidentally come into contact with mains AC voltages or high voltage DC. If you are not confident about working with projects employing mains voltages or other high voltages, you are advised not to attempt work on them. Silicon Chip Publications Pty Ltd disclaims any liability for damages should anyone be killed or injured while working on a project or circuit described in any issue of SILICON CHIP magazine. Devices or circuits described in SILICON CHIP may be covered by patents. SILICON CHIP disclaims any liability for the infringement of such patents by the manufacturing or selling of any such equipment. SILICON CHIP also disclaims any liability for projects which are used in such a way as to infringe relevant government regulations and by-laws.

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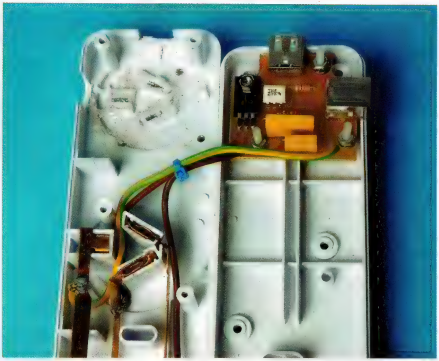
Digital dash plays havoc with Speed Alarm

I've built the PIC-based Speed Alarm from the November & December 1999 issues. I've got a digital-dash ZF Fairlane and the Speed Alarm sometimes loses the plot, with the display showing an interesting variety– eg, all 6's sometimes, all 0's at other times, etc.

Sometimes pressing the trip meter zeroing button returns it to normal. Maybe it's worse when it's cold. (P. C., Canberra, ACT).

● It seems that the digital dash electronics is causing erratic behaviour in the Speed Alert's PIC. Perhaps a metal plate that is earthed to chassis mounted on the back of the Speed Alert box will help. You may need to make up a folded aluminium cover for the base of the case, so it covers the back and all four sides of the box. Make sure it is earthed to chassis. **SC**

Notes & Errata



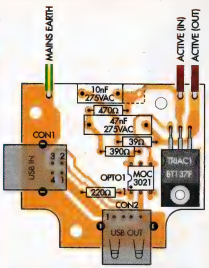


Fig.1: the revised parts layout and wiring diagram for the USB-Controlled Power Switch.

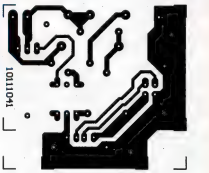


Fig.2: the revised PC board etching pattern.

USB-Controlled Power Switch, November 2004: it has come to our attention that some motherboards power the USB even when in standby mode. Apparently, this feature has been introduced to allow recharging of various accessories, as well as to allow mice and keyboards to initiate a power-up request from standby.

To use this project with a PC that powers the USB in standby mode, switch the mains power rather than relying on the "soft power" button on the front panel. This method has the added advantage of eliminating standby power usage, which saves you money!

Two small hardware changes have also been made to the project to improve user safety. Firstly, we've increased clearances between high voltage (mains) and low voltage (USB) tracks and pads on the PC board.

Secondly, we've modified the PC board so that the metal shells of the USB connectors are connected to mains earth. Earthing the on-board connectors ensures that the shields of any USB cables plugged into the power board are also earthed.

The accompanying overlay diagram (Fig.1) and photo show how to wire up the mains earth to the PC board. Use a short length of mains-rated green/yellow wire and strip enough insulation off one end so that you can wrap it around the earth bus bar one complete turn before soldering. Finally, secure the wiring using cable ties.

SMS Controller, October & November 2004: Under the "Assembly" and "Controller Checkout" sections on page 34 (part 1) and page 74 (part 2), IC3 is referred to as IC4 and vice versa.

PortaPal, February 2003: the bass pot (VR5) is shown on the circuit as 10kΩ. This should be 100kΩ as per the parts list. Second, the 100µF capacitor at pin 14 of IC9 should be shown as 100µF on the overlay, not 10µF. Finally, the overlay shows a 100nF capacitor in parallel with the 2200µF capacitor that's used to decouple the supply rail. This capacitor has been omitted from the circuit (the overlay is correct).

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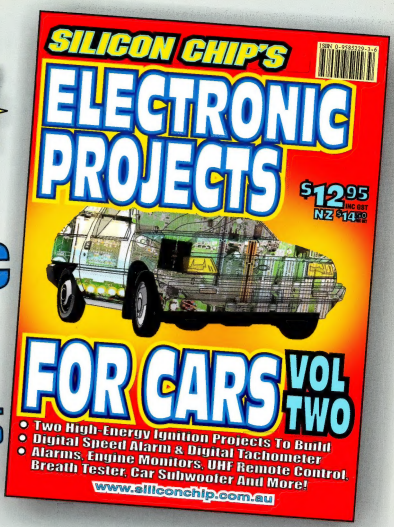

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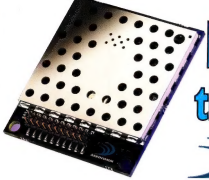

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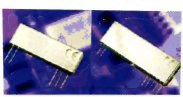

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